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DTR 4600 AND MODEL 2600

READOUT & CONTROL INSTRUMENTS

DTR 4600 AND MODEL 2600
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9/79

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SECTION I DISCRIPTION

1-1 INTRODUCTION

The Vibrac model DTR 4600 and 2600 instruments and associated spindle test heads offer a rapid, accurate means of evaluating or torque testing rotating (prime mover) devices. The test heads, configured in dynomometer form, have been designed with carefully selected spindle components that maintain the lowest inertia and frictional load levels allowing for accurate torque measurements free of cogging and inertia errors. The DTR 4600 and 2600 instruments have been designed to provide an accurate test head readout system and provides for convenient display and load controls.

1-2 DTR 4600 FRONT PANEL DESCRIPTION (see figure 1-1)

1-2-1 Power

Instrument power switch, push in for on and off. The lamp indicates that the switch is engaged.

1-2-2 Torque Readout

The 4½ digit meter is scaled to read dynamic torque test results in direct engineering units or in percent of full-scale.

1-2-3 Zero Adjust

The 10 turn potentiometer is for setting the proper zeroing lamp voltage of the dynamic spindle torque transducer

1-2-4 Torque Transducer Select

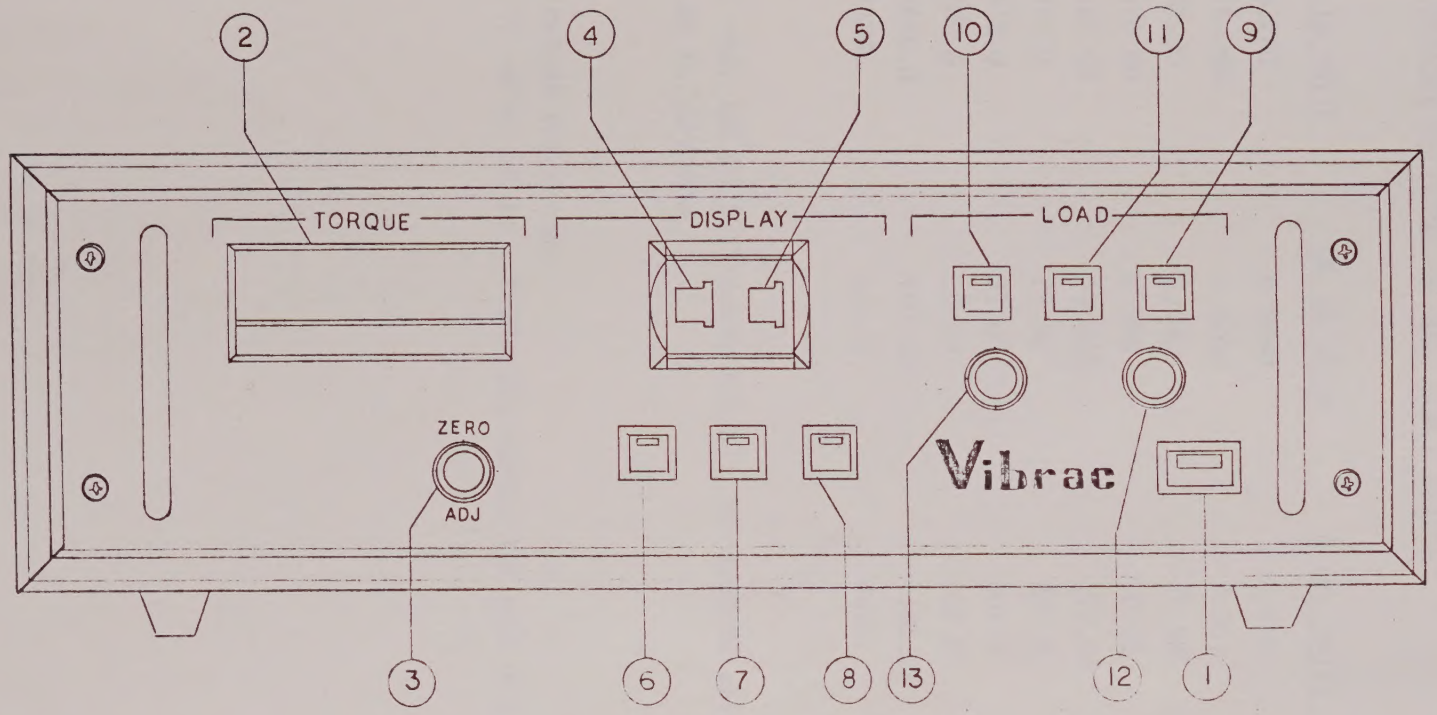
The thumbwheel switch is for scaling the torque readout to the torque transducer to be dispalyed. (see Table 1-1)

1-2-5 Torque Units Select

The thumbwheel siwtch is for selecting the desired engineering units to be displayed (see Table 1-1)

1-2-6 Peak Torque

The lighted push-button siwtch, when engaged will display peak torque from internal circuits on the torque readout (which is useful for dynamic pull-out torque measurements). The switch is electrically interlocked with the display hold and reset switches. The lamp indicates that the switch is engaged.



FRONT PANEL DTR 4600

FIGURE 1-1

TABLE 1-1

SPINDLE SELECTOR IN FULL SCALE READOUT

SPINDLE SELECTOR	OZ IN UNITS	LB IN UNITS	N CM. UNITS	TORQUE TRANSDUCER
T-1	3.200	0.2000	2.260	TQ-3.2
T-2	10.000	0.6250	7.061	TQ-10
T-3	32.00	2.000	22.60	TQ-32
T-4	100.00	6.250	70.62	TQ-100
T-5	160.00	10.000	113.00	TQ-160
T-6	400.0	25.00	282.5	TQ-400
T-7	512.0	32.00	361.5	TQ-512
T-8	800.0	50.00	565.0	TQ-800
T-9	1600.0	100.00	1130.0	TQ-1600
T-10	5120.	320.0	3615.	TQ-5120

% FS Selection reads 100.00 full-scale for all transducers which is useful for torque transducer calibration.

NOTES: Analog output for torque
0 to $\pm$ 10 volts = 0 to $\pm$ fullscale torque for each transducer listed above.

1-2-7 Display Hold

The lighted push-button switch, when engaged, will hold or lock the torque readout. The switch is electrically interlocked with the peak torque and reset switches. The lamp indicates that the switch is engaged.

1-2-8 Reset

The lighted push-button siwtch, when engaged, will dump the internal peak holding circuits and reset the peak torque and display hold switches. The lamp indicates that the switch is engaged.

1-2-9 Stall (auto load control)

The lighted push-button switch, when engaged, will control the dynamic spindle load brake to ramp (at a rate determined by ramp adjust 1-3-12) from 0 torque to that torque required to pull out the MUT. The switch is electrically interlocked with the torque and load OFF switches. The lamp indicates that the switch is engaged.

1-2-10 Torque (manual load control)

The lighted push-button switch, when engaged, will control the dynamic spindle load brake to manually set a torque load at a level determined by the torque adjust 1-3-13. The switch is electrically interlocked with the stall and load OFF switches. The lamp indicates that the switch is engaged.

1-2-11 Load OFF

The lighted push-button switch when engaged, will remove power from the dynamic spindle load brake. The switch is electrically interlocked with the stall and torque switches. The lamp indicates that the switch is engaged.

1-2-12 Ramp Adjust

The potentiometer is for setting the desired load ramp rate as described in 1-2-9.

1-2-13 Torque Adjust

The multi-turn potentiometer is for setting the desired manual torque load as described in 1-3-10.

1-3 2600 FRONT PANEL DESCRIPTION (see figure 1-2)

1-3-1 Power

Instrument power switch, push in for on and off. The lamp indicates that the switch is engage.

1-3-2 Torque Readout

The 4½ digit meter is scaled to read dynamic torque test results in direct engineering units or in percent of full-scale.

1-3-3 Zero Adjust

The 10 turn potentiometer is for setting the proper zeroing lamp voltage of the dynamic spindle torque transducer.

1-3-4 Torque Transducer Select

The thumbwheel switch is for scaling the torque readout to the torque transducer to be dispalyed (see Table 1-1).

1-3-5 Torque Units Select

The thumbwheel switch is for selecting the desired engineering units to be displayed (see Table 1-1).

1-3-6 Peak Torque

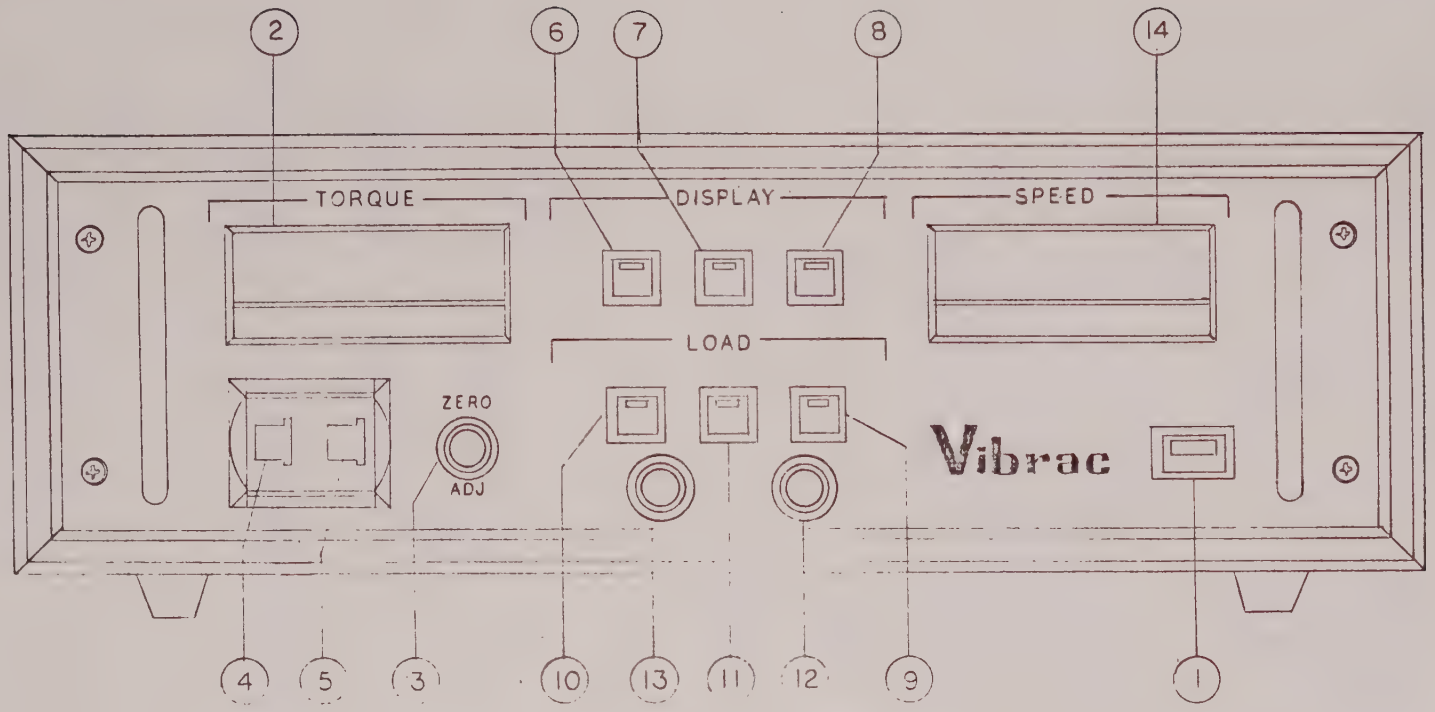
The lighted push-button switch, when engaged will display peak torque from internal circuits on the torque readout (which is useful for dynamic pull-out torque measurements). The switch is electrically interlocked with the display hold and reset switches. The lamp indicates that the switch is engaged.

1-3-7 Display Hold

The lighted push-button switch, when engaged, will hold or lock the torque readout 1-3-2. and the speed readout meters. The switch is electrically interlocked with the peak torque and reset switches. The lamp indicates that the switch is engaged.

1-3-8 Reset

The lighted push-button switch, when engaged, will dump the internal peak holding circuits and reset the peak torque and display hold switches. The lamp indicates that the switch is engaged.



FRONT PANEL 2600

FIGURE 1-2

1-3-9 Stall (auto load control)

The lighted push-button switch, when engaged, will control the dynamic spindle load brake to ramp (at a rate determined by ramp adjust) from 0 torque to that torque required to pull out the MUT. The switch is electrically interlocked with the torque and load off switches. The lamp indicated that the switch is engaged.

1-3-10 Torque (manual load control)

The lighted push-button switch, when engaged, will control the dynamic spindle load brake to manuall set a torque load at a level determined by the torque adjust. The switch is electrically interlocked with the stall and load off switches 1-3-11. The lamp indicates that the switch is engaged.

1-3-11 Load Off

The lighted push-button switch when engaged, will remove power from the dynamic spindle load brake. The switch is electrically interlocked with the stall and torque switches. The lamp indicates that the switch is engaged.

1-3-12 Ramp Adjust

The potentiometer is for setting the desired load ramp rate as described in 1-3-9.

1-3-12 Torque Adjust

The multi-turn potentiometer is for setting the desired manual torque load as described in 1-3-10.

1-3-14 Speed Readout (2600 instrument only)

The 4½ digit meter is scaled to read speed in RPM engineering units.

1-4 MODELS 2600 AND DTR 4600 REAR PANEL DESCRIPTION (see Figure 1-3)

1-4-1 Power Receptacle

115 V AC, 60 Hz Input.

1-4-2 Power Rate

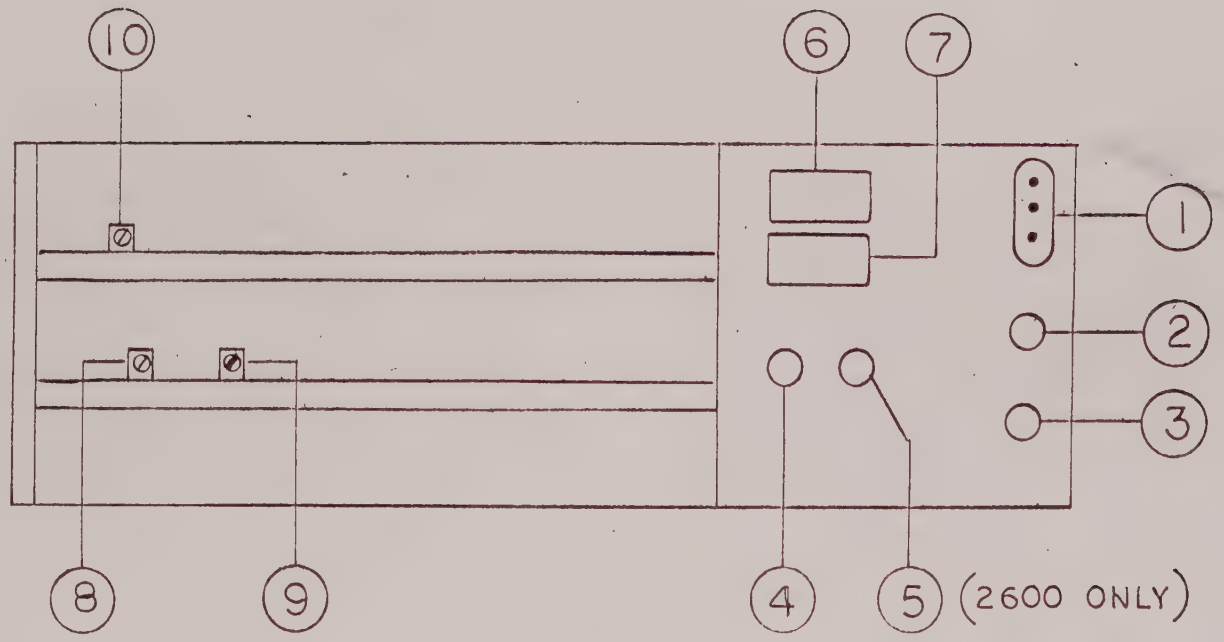
System power fuse (3 amp Slo-Blo fuse).

1-4-3 Load Supply Fuse

Loading device power supply fuse (1 amp Slo-Blo fuse).

1-4-4 Torque Output

Analog torque output connector (matting connector-UG88/M or equivalent).



REAR PANEL
DTR 4600 AND MODEL 2600

FIGURE 1-3

1-4-5 Speed Output (2600 instrument only)

Analog speed output connector (mating connector UG88/M or equivalent).

1-4-6 Transducer Input

Transducer input connector, connections supplied.

1-4-7 BCD Output

BCD output connector (optional). (See Table 1-2)

1-4-8 Torque Offset Adjust

(see Section 5)

1-4-9 Torque Calibration

(see Section 5)

1-4-10 Stall Set

(see Section 5)

TABLE 1-2

BCD Output Run List

01	BCD	1
02	BCD	2
03	BCD	4
04	BCD	8
05	BCD	10
06	BCD	20
07	BCD	40
08	BCD	80
09	BCD	100
10	BCD	200
11	BCD	400
12	BCD	800
13	BCD	1000
14	BCD	2000
15	BCD	4000
16	BCD	8000
17	BCD	10000
18	+ Polarity	
19	$\overline{\text{Print Command}}$	
20	Ground	
21 - 25	N.C.	

SECTION II INSTALLATION AND OPERATION

2-1 GENERAL

Retain all packaging materials in the event that the instrument(s) must be returned to the factory.

2-2 RECEIVING INSPECTION

After opening the package, the instrument(s) should be carefully inspected for damage. Any damage should be promptly reported to the shipping agent and to Vibrac.

2-3 INSTALLATION

All instruments manufactured at Vibrac are 115VAC, 60 Hz operation.

2-3-1 Input Connections

The transducer input connector (rear panel) is intended for use with Vibrac optical torque transducers only.

Connect the power cable provided from the instrument rear panel AC receptacle to a convenient 115 VAC, 60Hz power source.

Connect the torque transducer and speed transducer (where applicable) with transducer cable provided and connect to the instrument transducer input. Connect the load power cable to the load output connector.

2-3-2 Output Connections

Analog torque and speed outputs (where applicalbe), are provided at the rear panel via BNC connectors. These outputs are intended for plotter and recorder use only.

2-3-3 Safety Precautions

As with all rotationg testing devices, certain safety precautions should be instituted. For example precautions should be taken to assure that fingers, tools and clothing are clear of the rotating members of the test spindles. Suitable local safety measures should be instituted to satisfy in-house regulations. Recommendations might include operator training, transparent safety housings or enclosures and or warning signs or labels.

2-4 OPERATING INSTRUCTIONS

2-4-1 General

Once the proper input power and the proper input connections are assured, press the instrument power switch to the "On" position. Press the "Off" switch in the "Load" section to

to assure that no power is applied to the load brake. Adjust the "Zero Adjust" for a zero torque indication on the digital torque meter (this adjustment must be made with no load applied to the torque transducer). Allow a 30 minute warm-up period before attempting any test. After the warm-up period, re-adjust the zero adjust potentiometer if required. With a suitable fixture and coupling, couple the DUT to the dynamometer spindle. The system is now ready for operation.

2-4-2 Manual Load Control

To select the namual mode, depress the "Torque" push-button switch and adjust the "Torque Adjust" potentiometer to the desired load level. Speed and torque levels will be displayed on their respective digital meters. To terminate the test, depress the "Off" push-button switch. This will remove power from the load brake.

2-4-3 Automatic Load Control

To utilize the automatic load application mode of operation adjust the "Ramp Adjust" potentiometer to the desired ramp level) then depress the "stall" push-button switch. The load will be ramped from no load to full load at the pre-set rate. To terminate the test, depress the "Off" push-button switch. This will remove power from the brake.

2-4-4 Peak

To select the peak mode, press the "Peak" switch in the "Load" section. If the device under test, during a specific test run, has passed through a distinguishable peak torque point, internal holding circuits will have sotred this peak torque level. By pressing the "Peak" switch, the stored value is recalled and displayed on the torque digital readout. To reset and terminate the peak mode, press the "Reset" switch. Note: Press the "Reset" switch prior to every test run.

2-4-5 Hold Displays

To lock or hold both the digital torque and speed meters, press the "Hold Displays" push-button switch. Both the digital torque and speed meters will be locked to their last instantaneous readings.

SECTION III SPECIFICATIONS

3-1 INTRODUCTION

This section provides rated capacities, overload capacities, components accuracies and overall accuracies of each sub system and all torque transducers of this test stand.

3-2 TORQUE TRANSDUCERS (see data sheet-Bulletin 400)

Type - Bearing mounted, torsion bar using optical method of torque measuring.

Slip Rings and Brushes - None

Strain Guages - None

Full-scale Torque - as indicated on name plate

Overall Accuracy - $\pm$ 1.0% of span (includes ripple, linearity, hysteresis and calibration).

Overload Capacity - $\pm$ 100%

Calibration Method - Static weight and monent beam traceable to NBS

Output - $\pm$ 100 microampers = $\pm$ 100% F.S.

3-3 SPEED TRANDSUCERS

Type - Low inertia DC tachometer

Linearity - .1% span

Overall Accuracy - $\pm$ 0.5% of span

3-4 DYNAMIC TORQUE SPINDLES

3-4-1 Loading Device

Load brake type - Magnetic Particle Brake

Speed Range - see Table 3-1

Torque Capacity - see Table 3-1

Drag Torque - Less than 2 percent of span

Moment of Inertia - see Table 3-1

3-5 DTR 4600 and MODEL 2600 ISNTRUMENT

3-5-1 Torque Display

Display - 4½ digit readout

Accuracy - $\pm$ 0.25% of span $\pm$ 1 digit

Selection Switch for Oz-in, N_CM lb-in and % F.S. units.

3-5-2 Speed Display (2600 only)

Display - 4½ digit readout

Accuracy - $\pm$ 0.25% of span $\pm$ 1 digit

TABLE 3-1

DTR 4600 SERIES - TORQUE SPINDLES

	MAX. TORQUE	MAX. SPEED (RPM)	TOTAL MOMENT OF INERTIA	NON EXCITED TORQUE (FRICTION)	MAX. CONT. POWER (WATTS)	MODEL DTL4610	SHAFT DIAMETER
1	10 OZ.-IN.	3000	4.67×10^{-4} (33)	0.5 OZ-IN	25	10	.250
2	32 OZ.-IN.	3000	4.67×10^{-4} (33)	2 OZ-IN	50	32	.250
3	100 OZ.-IN.	2000	7.43×10^{-4} (52.5)	2 OZ-IN	100	100	.250
4	160 OZ.-IN	2000	37×10^{-4} (260)	4 OZ-IN	100	160	.500
5	400 OZ.-IN	2000	86×10^{-4} (610)	1 IN-LB	150	400	.500
6	512 OZ.-IN	2000	130×10^{-4} (918)	2 IN-LB	150	512	.500
7	800 OZ.-IN	2000	130×10^{-4} (918)	2 IN-LB	150	800	.625
8	1600 OZ.-IN	2000	190×10^{-4}	2 IN-LB	200	1600	.625

3-5-3 Dynamic Torque Load Control

Off - Turn off all power to load brake

Torque - Causes the load brake to be controlled by the torque adjust control.

Stall - Causes the load brake to be automatically ramped at a rate set by the ramp adjust control.

3-5-4 Display Controls

Peak - Causes stored peak torque level to be displayed on torque readout. (Overall accuracy = ± 1% of span & torque transducer accuracy).

Hold - Causes torque and speed readouts to latch (last reading)

Reset - Dumps peak circuits and resets peak and hold controls

3-5-5 Analog Outputs

Torque - 0 to ± 10 VDC = 0 to ±100% torque (Overall accuracy = ± 0.2% of span & torque transducer accuracy)

Speed - (2600 system only) 1VDC per 1000 RPM (Overall accuracy = ± 0.1% of span & speed transducer accuracy).

SECTION IV SYSTEM DESCRIPTION

4-1 INTRODUCTION

This section is intended to aquaint the user with the basic concept of this instrument system. Breif descriptions of the various sub-assemblies, components and circuits utilized in this system will follow.

4-2 DYNAMIC TORQUE SPEIDLE (see Figure 4-1)

4-2-1 Spindle Description

The dynamic torque spindle consisting of a low inertia magnetic particle load brake and a Vibrac optical torque transducer will provide a smooth, precise torque load to the MUT and allow for dynamic torque measurements to evaluate motor performance.

4-2-2 Torque Transducer (see Figures 4-2 & 4-3)

The torque transducer provides signal data to be used in conjunction with the torque section of the instrument package. The transducer output is -100 microamperes for full CW torque and +100 microamperes for full CCW torque.

Two lamps, wired in series, and a reference photocell are mounted to one end of the transducer housing, and the two torque-measuring photocells are mounted at the other end of the transducer housing. Two identical code disks are mounted on a pair of sleeves that are attached to opposit ends of the torsion shaft. The light from the lamps shines through the slots in the code disks and impinges on the photocells, thus generating a DC current. The two disks are aligned so that the slots in one overlap the other by 50%. A twist of the shaft in the CW direction decreases the overlap allowing more light to shine through and more current to be generated. A twist in the CCW direction increases the overlap allowing less light and less current output.

Internally adjusting a bias circuit calibrates the transducer at a specific lamp voltage.

The reference photocell samples the lamp intensity to generate a current which is used in a feedback system to maintain constant lamp intensity at the photocells. This automatic regulating feature minimizes zero adjustments due to lamp aging,

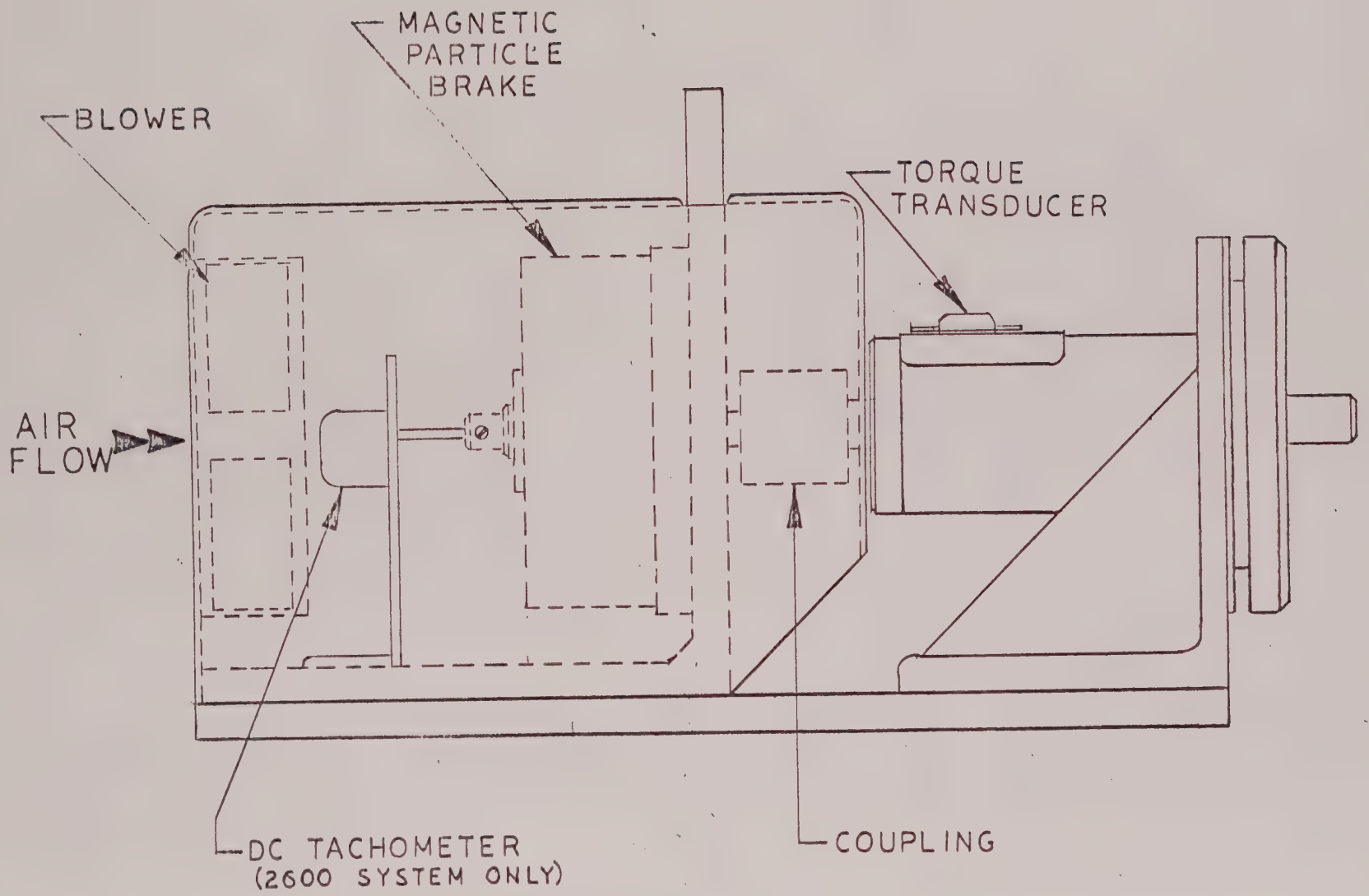


FIGURE 4-1

DYNAMIC SPINDLE ASSEMBLY

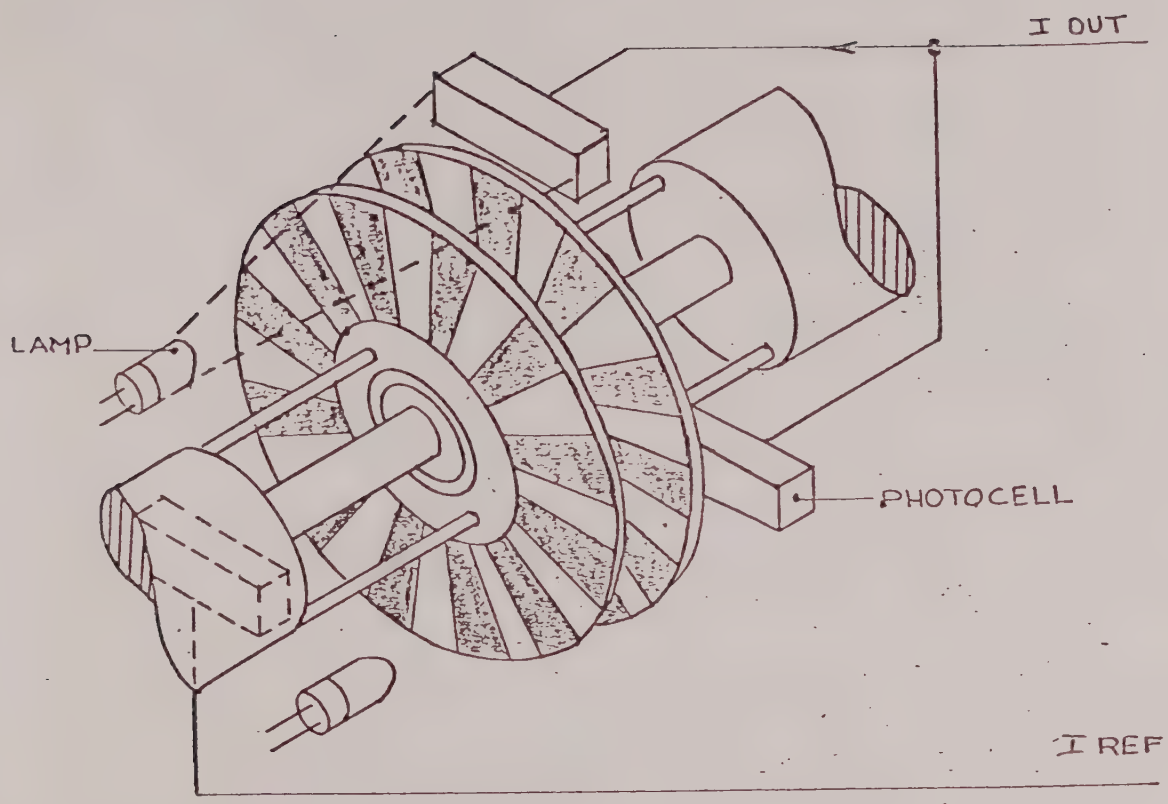


FIGURE 4-2

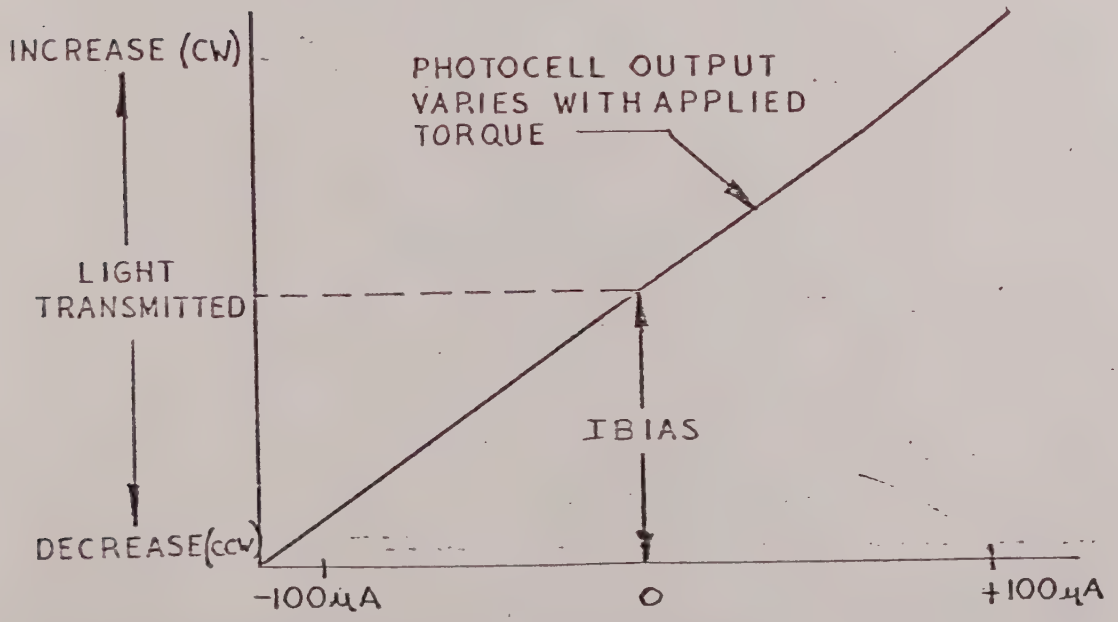


FIGURE 4-3

power supply changes, etc.

4-3 CONSOLE

The consoles are rigid cabinet device intended to house the system sub-assemblies and components. The cabinets are for standard 19 inch panel widths.

4-4 DTR 4600 and MODEL 2600 READOUT/CONTROL INSTRUMENT (see Figure 4-4)

The instrument is the main control and readout section of the torque testing system. It provides the operator with a means of controlling testing paramenters and reads out the test results. The instrument configuration is in sub-assemble form and consists of a front panel assembly to house the applicable readouts and controls, a chassis, appliable power supplies, wire harness assemblies and printed circuit boards.

Three printed circuit boards contain all the required circuitry for control and signal processing. The torque transducer outputs from the dynamic and static torque spindles are processed through two signal conditioner boards and a digital logic board contain the logic circuitry which allows for test parameter control.

4-4-1 Torque Signal Conditioner Board

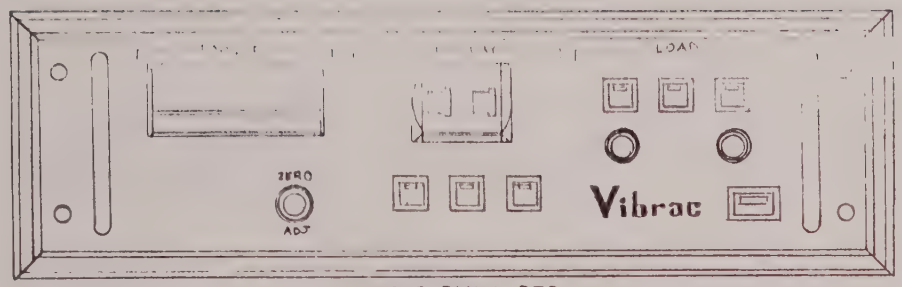
The signal conditioner board assembly contains required torque signal processing circuitry required to convert the torque transducer output signal to a usable signal representing engineering data that will be displayed on the torque readout and load brake regulator. Circuit description will follow.

4-4-1-1 Torque Signal Conditioner (see Figure 4-5)

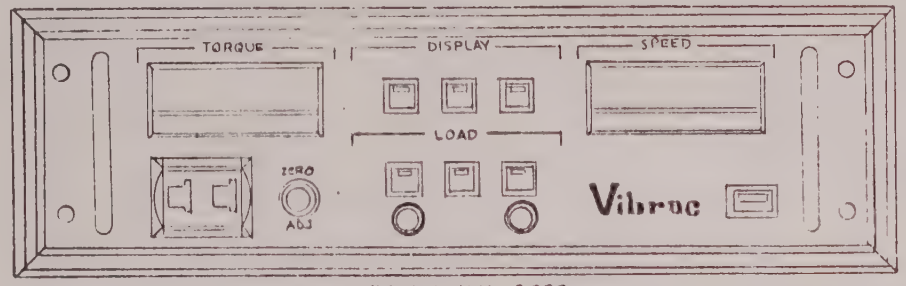
The circuit converts the torque transducer signal output to a DC voltage. There are two outputs from this circuit. The first output (current to voltage converter -ICIC) is Bypolar and is scaled to represent the torque. The second output (precision rectifier) is Unipolar and is scaled by the first (Bypolar stage). The precision rectifier consists of IC3C (current source) and IC3B whose output is positive and proportional to the Bypolar output of ICIC.

4-4-1-2 Lamp Driver Circuit (see Figure 4-6)

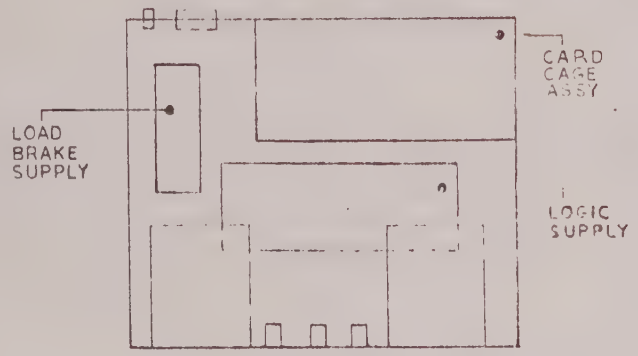
The circuit regulates the torque transducer lamp voltage by means of a series regulator controlled by an



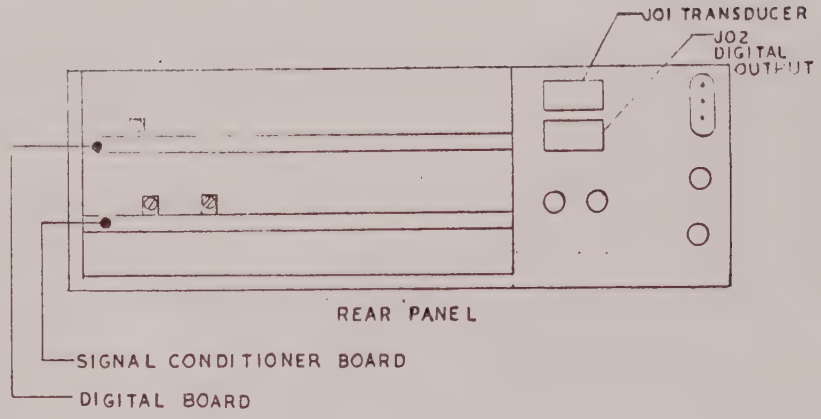
FRONT PANEL DTR



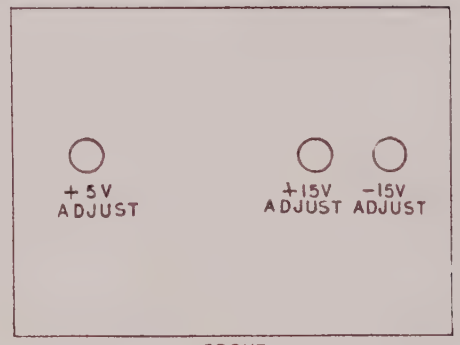
FRONT PANEL 2600



TOP VIEW



REAR PANEL



FRONT

BOTTOM VIEW

DTR 4600/2600 INSTRUMENTS

FIGURE 4-4

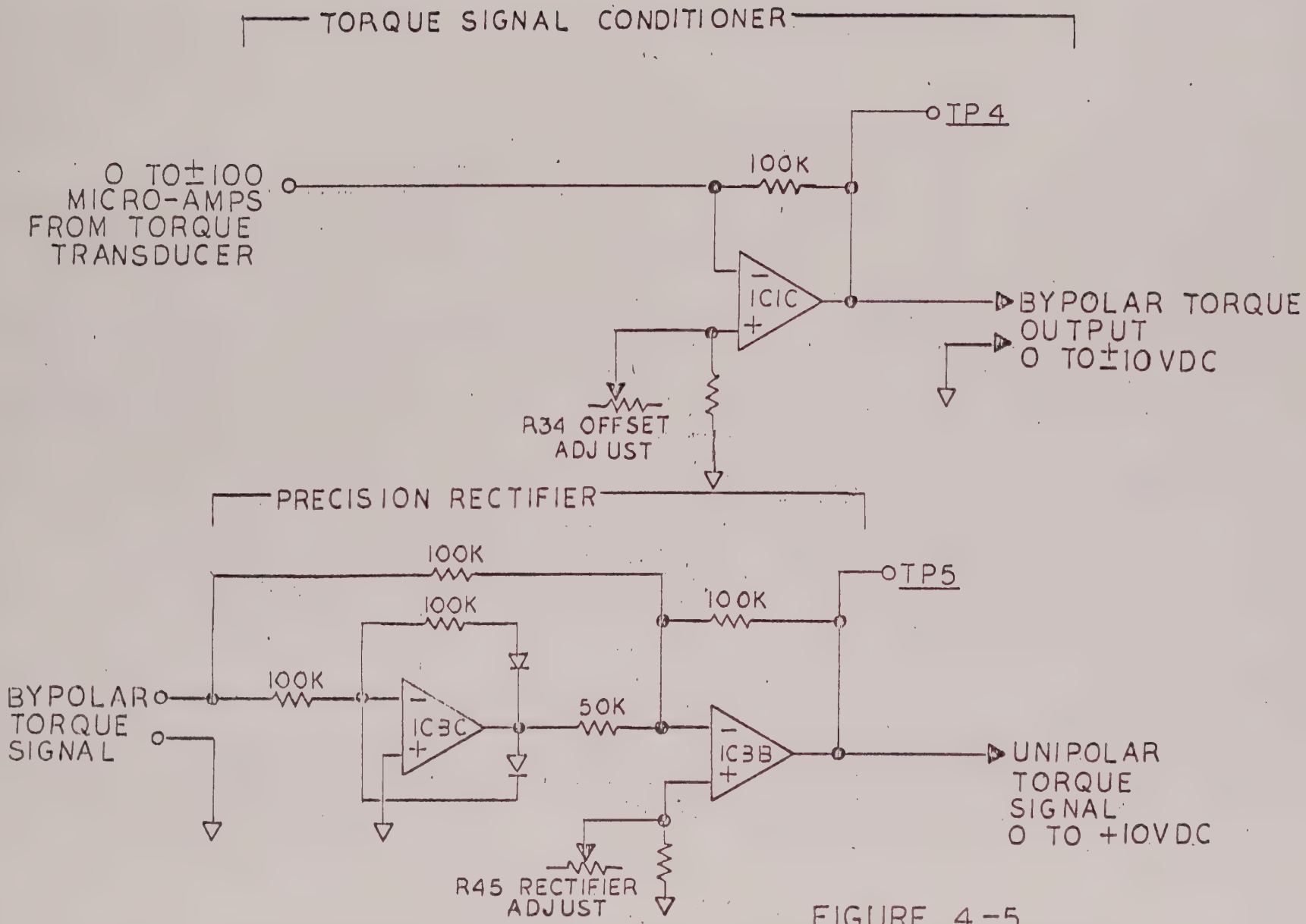


FIGURE 4-5

SIMPLIFIED DIAGRAM OF TORQUE SIGNAL CONDITIONER

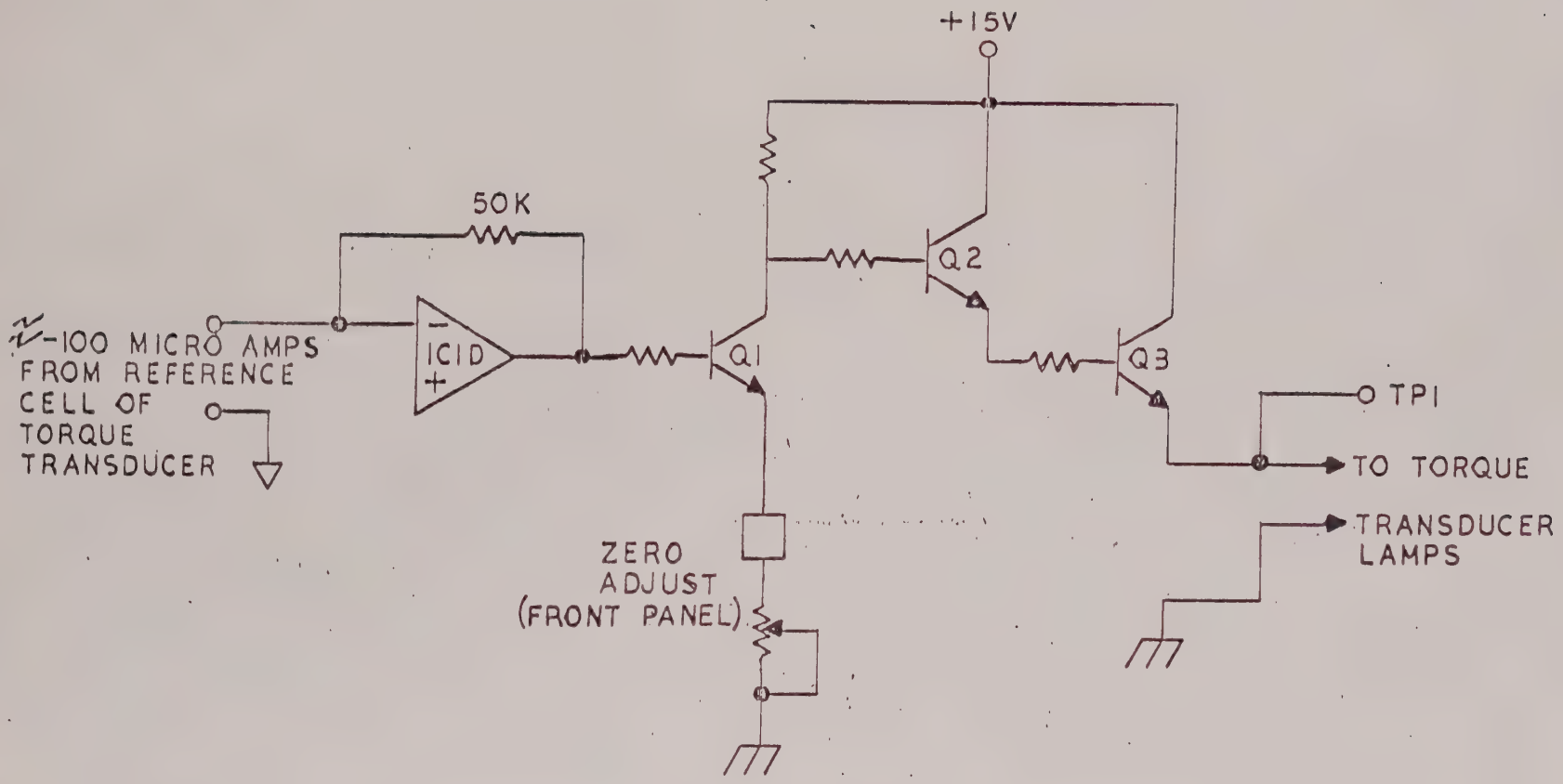


FIGURE 4-6

SIMPLIFIED DIAGRAM OF LAMP DRIVER CIRCUIT

operational amplifier. The operating point is maintained with the fron panel "zero adjust" control. A reference photocell, mounted in the torque transducer is utilized to monitor the lamp output intensity. This reference photocell output is fed back to the inverting input of ICID whose output sets the operating level of current source Q1. The zero adjust control will vary the bias level of the current source whose output then passed to the series regulator Q2 & Q3 to control lamp intensity in the torque transducer.

4-4-1-3 Peak Torque Detector and Hold Circuit (see Figure 4-7)

The circuit consist of two stages. The first stage is a detector circuit whose input is the unipolar torque signal described in 4-4-1-1 (torque signal conditioner). The detector circuit is a simple buffer circuit whose feedback network is altered by the diode CR4. A large capacitor is placed across the output of the detector. As the input of the detector is increasing, the capacitor is changing. If the input starts to decrease, the diode in the feedback loop prevents the capacitor from discharging therefore, the charge on the capacitor represents a peak signal level. The peak signal is buffered then distributed to the peak comparator circuit. The sample hold circuit utilizes a low input bias operational amplifier whose output is inversely proportional to the input peak signal. The circuit is commanded to hold by simply removing the input signal.

The unipolar torque signal from 4-4-1-1 is fed to the detector IC4C. The feedback loop includes diode CR4 which pass only positive going signals to chand the capacitor C16. If the input signal devrese CR4 will not allow a feedback path and discharge path for C16. Therefore, the peak signal is represented across C16. This output is buffered by IC4D. Resetting the circuit is accomplished by momentarily shorting C16, thus inverter circuit IC4A and then to the inverting input of IC9 (hold circuit). This signal is applied through a set of

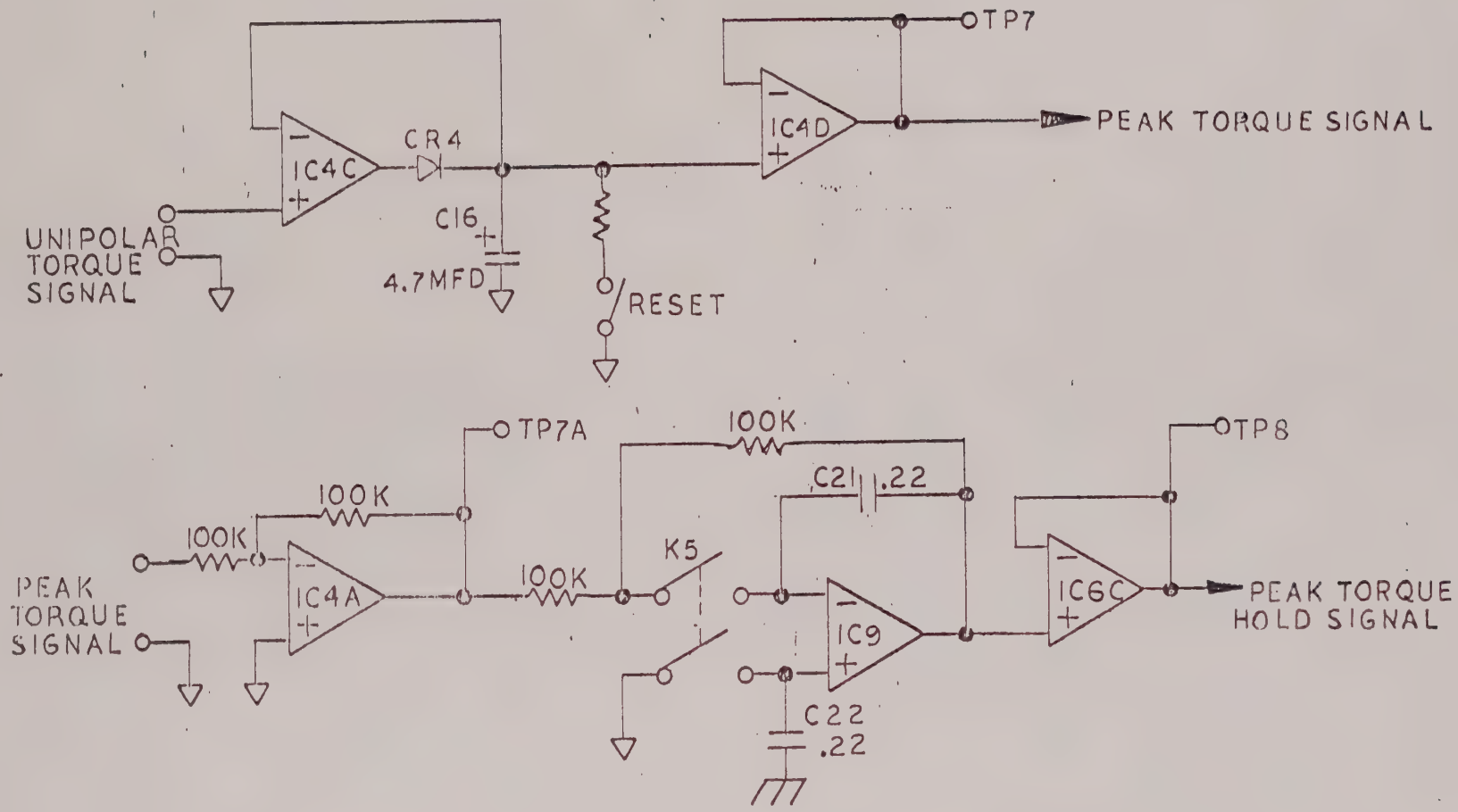


FIGURE 4-7

SIMPLIFIED DIAGRAM OF PEAK DETECTOR & HOLD CIRCUIT

contacts of relay K5. The feedback capacitor C21 is charged to the input voltage. When K5 is commanded to de-energize (see 4-4-1-1), the relay contacts open and the input is removed. The feedback capacitor now has no discharge path, thus holds to signal voltage (peak torque).

4-4-1-4 Peak Torque Comparator Circuit (see Figure 4-8)

The circuit samples the buffered peak torque signal from IC4D (see 4-4-1-3) and the unipolar torque signal from IC3B (see 4-4-1-1) at the point when the peak torque signal is greater than the unipolar torque signal, the comparator trips a reed relay (K5) which, in turn commands the sample hold circuit IC9 to store (or hold) the peak torque signal.

4-4-1-5 Load Regulator Circuit (see Figure 4-9)

The circuit is used to requlate the dynamic torque load brake. Input biasing is switched on the digital board. The regulator may be used automatically with the ramp generator circuit or manual by use of the front panel torque adjust control.

The selected input bias is fed to the series pass regulator Q11 and Q12, whose output is fused then applied to the dynamic torque load brake (0 to 24 VDC).

4-4-1-6 Speed Signal Conditioner Circuit (2600 Systems only)

The signal conditioner circuits converts the DC tachometer to a DC voltage. The output is proportional to shaft velocity and scaled to be displayed on the speed readout in RPM.

4-4-2 Digital Logic Board

The logic board assembly contains required switching logic, relay circuits and bias control circuitry to control and select all the functions of the instrument. General circuit descriptions will follow. Note all logic levels are Logic 1=high=5V; 0=low=0V. All input selection points are selected by applying logic 0 to that input. A buss line (Li) is provided at the front panel push-button controls. When in local control, the buss (L1) is at logic level 0. When in remote control, the

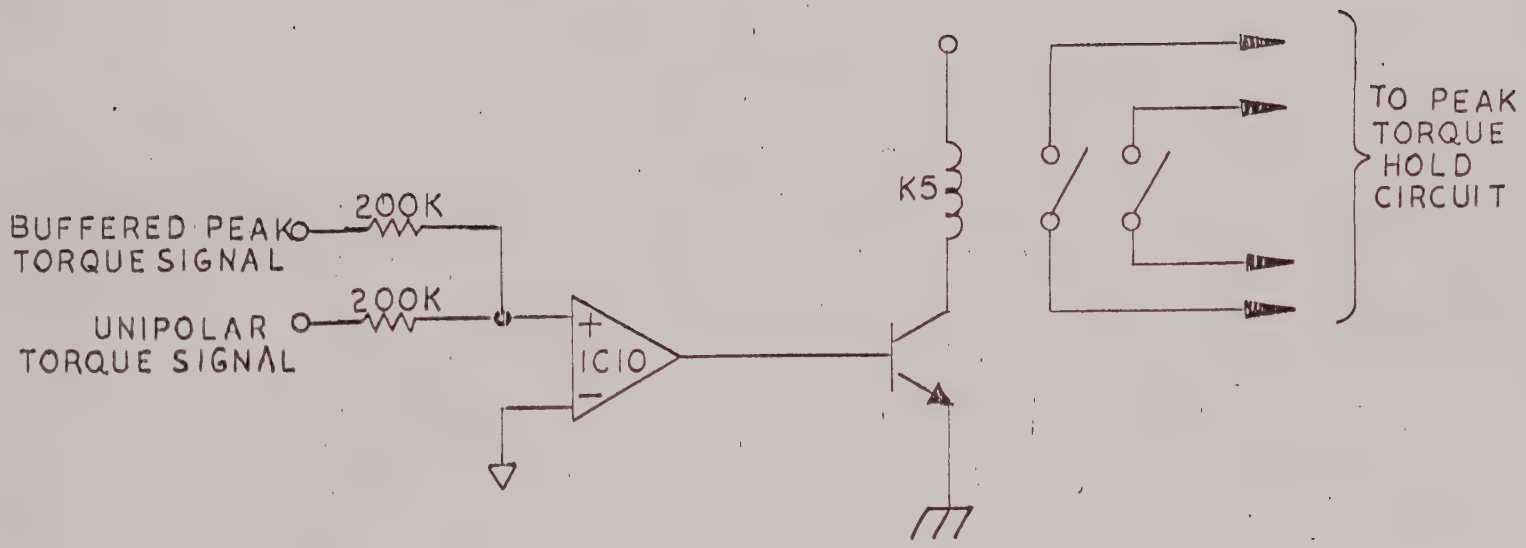


FIGURE 4-8

SIMPLIFIED DIAGRAM OF PEAK TORQUE COMPARATOR CIRCUIT

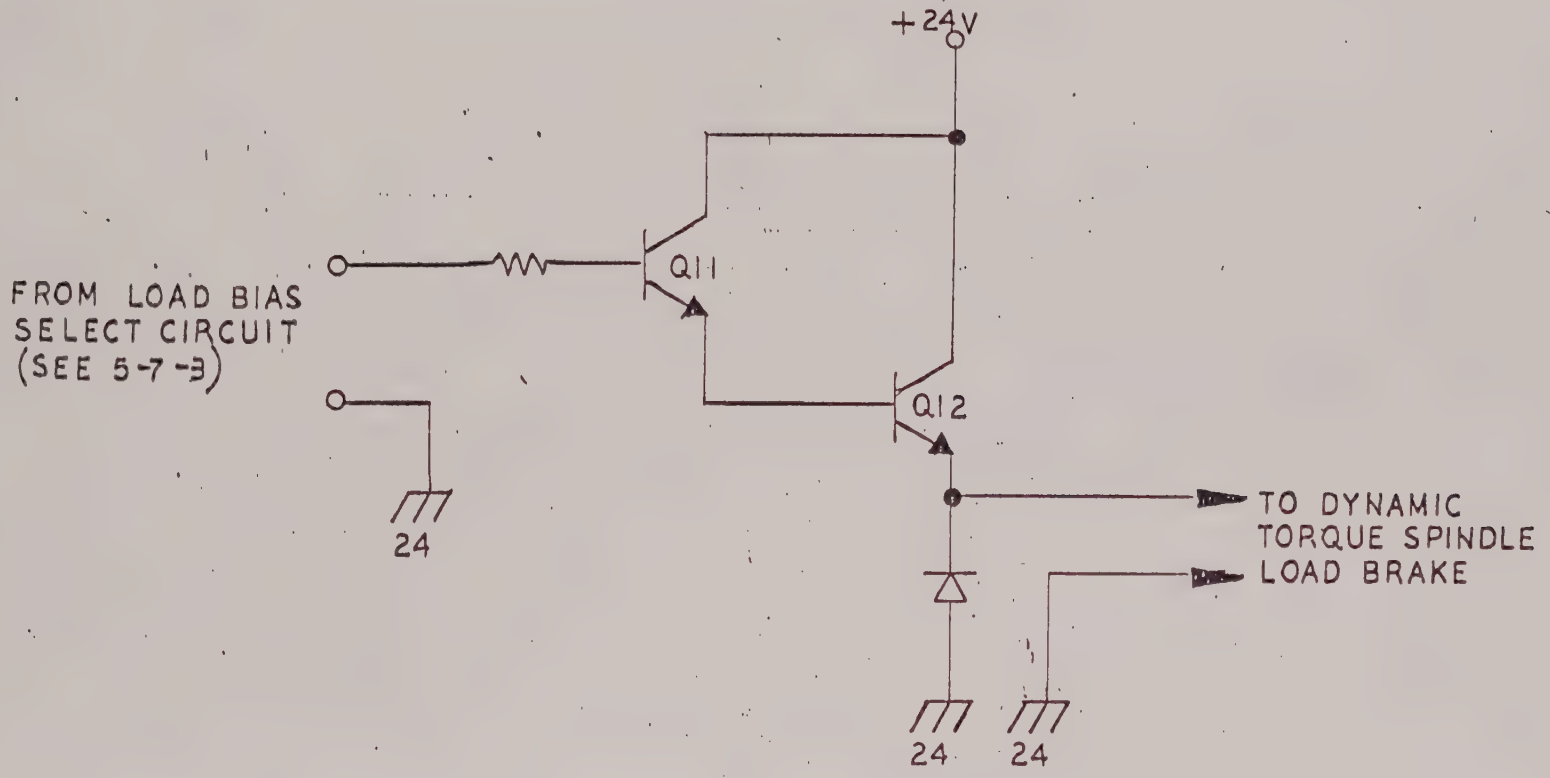


FIGURE 4-9

SIMPLIFIED BLOCK DIAGRAM OF LOAD REGULATOR

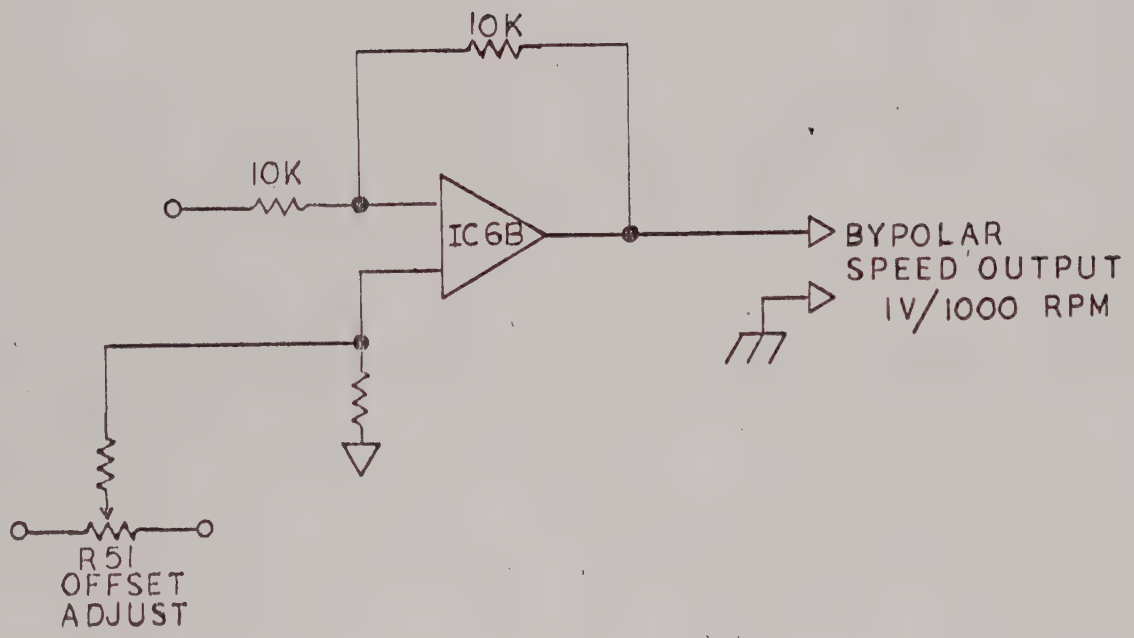

10K
10K
IC6B
BYPOLAR
SPEED OUTPUT
1V/1000 RPM
R51
OFFSET
ADJUST

FIGURE 4-10

buss (L1) is held at logic level 1 therefore no front panel controls will apply.

4-4-2-1 Status Set (see Figure 4-11)

To assure that the load control is in the off mode and that desired status levels are maintained during initial turn-on, an ORC circuit is utilized.

4-4-2-2 Local/Remote Select (see Figure 4-11)

To select the remote control mode hold input low. To maintain local control, hold input high.

4-4-2-3 Load Off Select (see Figure 4-12)

The logic circuit is for resetting the torque select and locked rotor select circuits to the "off" mode. Circuit selection is accomplished by low level logic trip sets.

4-4-2-4 Torque Select (Manual) (see Figure 4-12)

The flip-flop circuit is for selecting the manual torque load mode of operation. The circuit is electrically interlocked with the locked rotor flip-flop circuit. Circuit selection and reset are accomplished by low logic level trip sets.

4-4-2-5 Stall Select (see Figure 4-12)

The flip-flop circuit is for selecting the automatic (ramped) torque load mode of operation. The circuit is electrically interlocked with the torque flip-flop circuit Circuit selection and reset are accomplished by low logic level trip sets.

4-4-2-6 Peak Display Select (see Figure 4-13)

The flip-flop circuit is for selecting the peak torque readout mode of the torque readout. The circuit is electrically interlocked with the hold displays and reset circuits. Circuit selection and reset are accomplished by low logic level trip sets.

4-4-2-7 Hold Displays Select (see Figure 4-13)

The flip-flop circuit is for controlling the torque readout and speed readout (2600 only) into the display hold mode of operation. The circuit is electrically interlocked with the peak select and reset circuits. Circuit selection and reset are accomplished by low logic level trip sets.

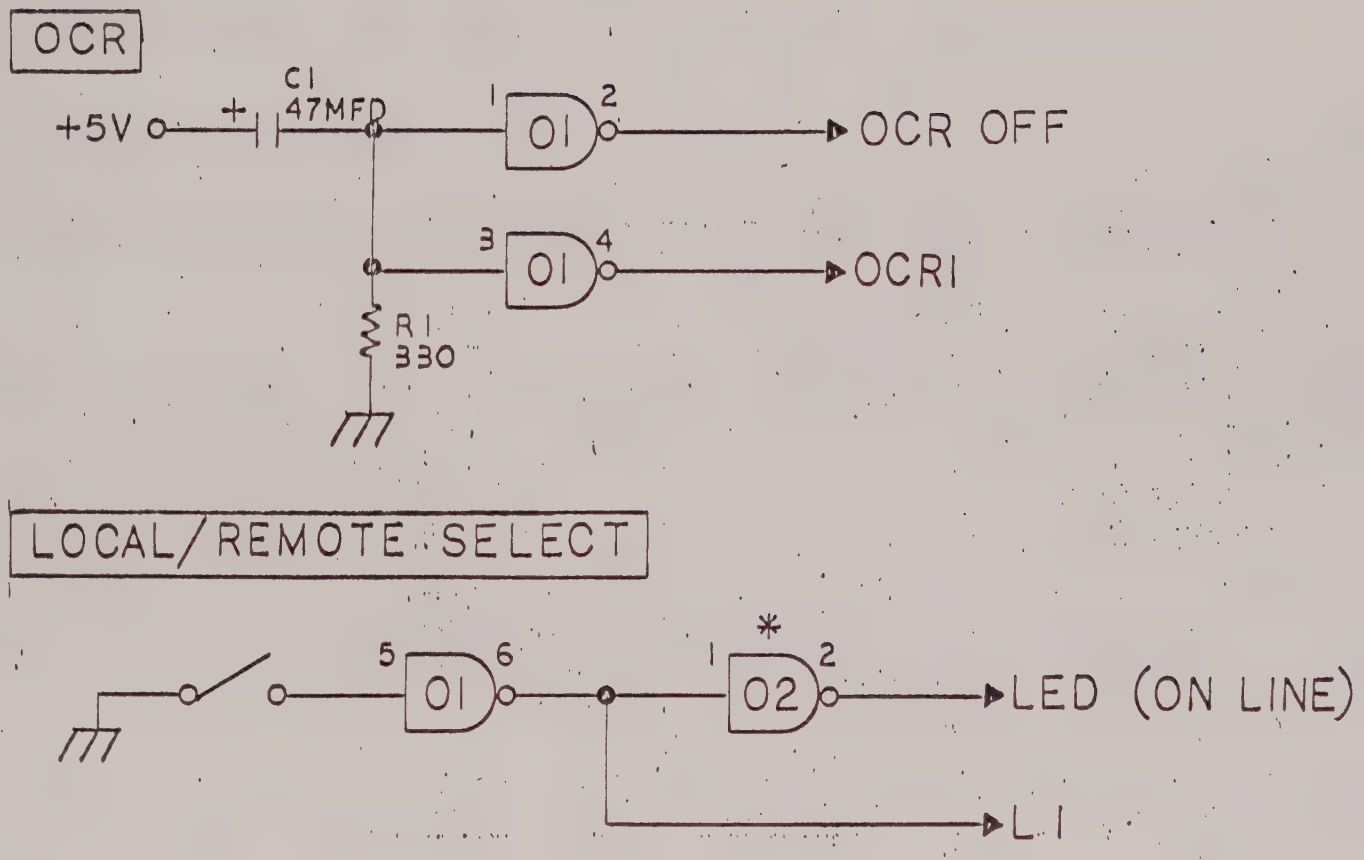


FIGURE 4-11

OCR SET & L/R REMOTE SELECT

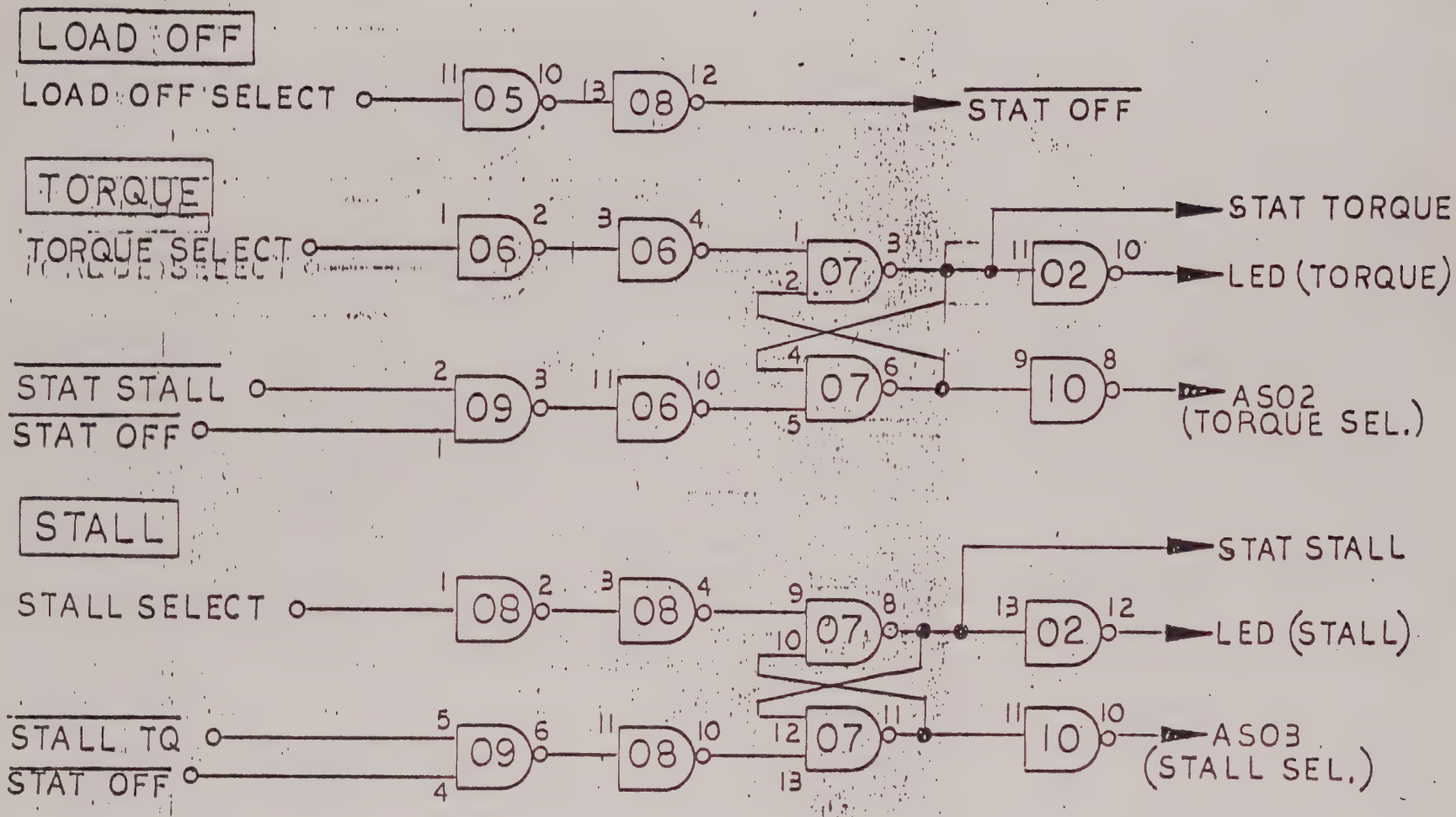


FIGURE 4-12

LOAD CONTROL SELECT CIRCUIT

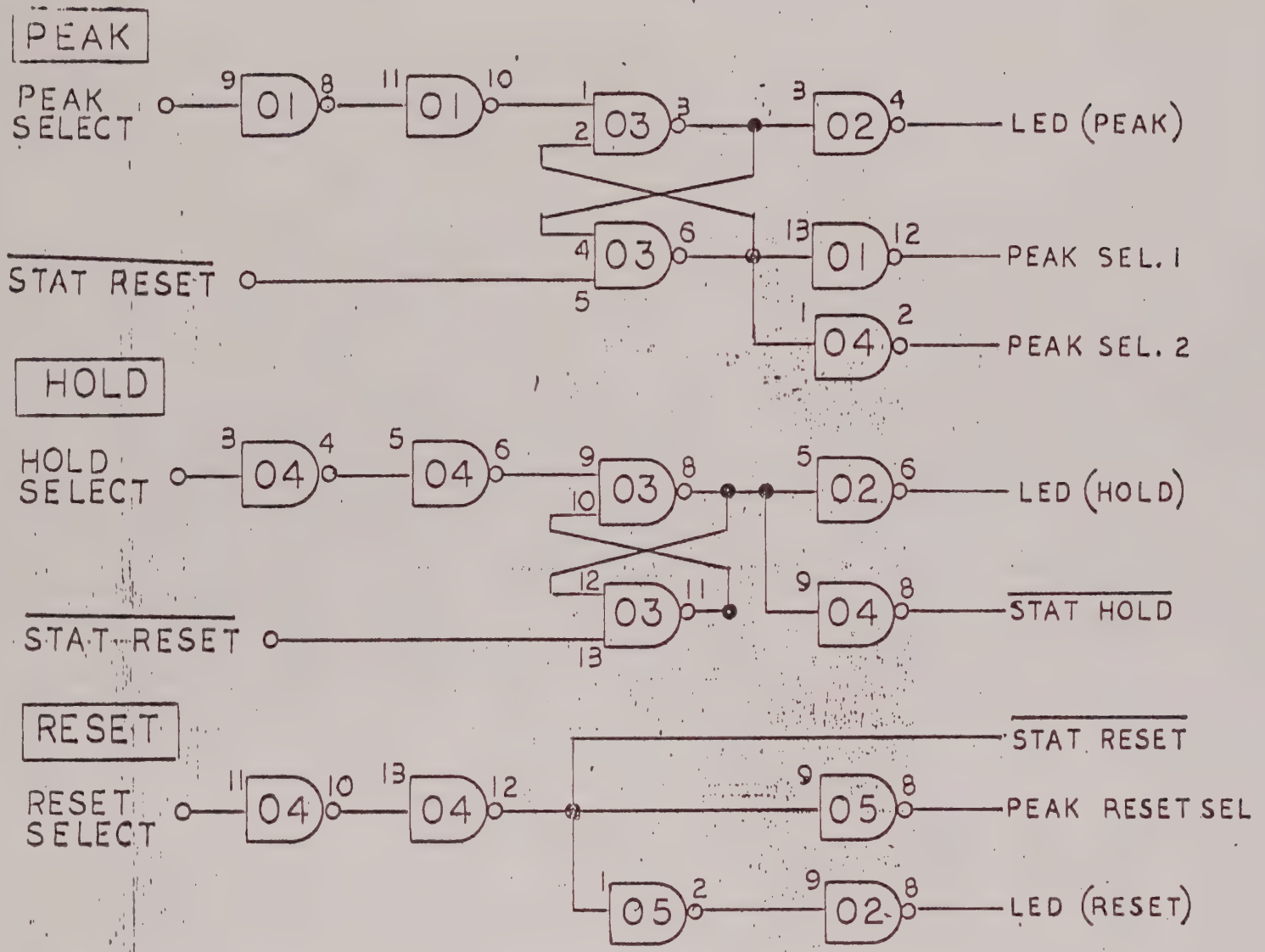


FIGURE 4-13

DISPLAY SELECT CIRCUIT

4-4-2-8 Display Reset Select (see Figure 4-13

The logic circuit is for reseting the peak display and hold display circuits. Circuit selection is accomplished by low logic level trip sets.

4-4-2-9 Ramp Circuit Input Select (see Figure 4-14)

The analog switch circuit is for selecting the input bias level of the ramp generator circuit. Circuit selection is accomplished by a relay driver circuit which is selected by the stall select circuit.

4-4-2-10 Load Regulator Input Select Ramp Mode (see Figure 4-14)

The analog switch circuit is for selecting the automatic mode of operation of the load regulator circuit. As the circuit is selected by the stall select circuit an analog switch will apply the ramp generator output to the load regulator circuit. Circuit selection is accomplished by the relay driver circuit AS03 which is controlled by the stall select circuit.

4-4-2-11 Load Regulator Input Select/Manual Mode(see Figure 4-14

The analog switch circuit is for selecting the manual mode of operation of the load regulator circuit. As the circuit is selected by the torque select circuit an analog switch will apply the torque set signal (from front panel torque adjust control) to the load regulator circuit. Circuit selection is accomplished by the relay driver circuit AS02 which is controlled by the torque select circuit.

4-4-2-12 Ramp Gnerator Circuit (see Figure 4-15)

The circuit provides the load regulator with a smooth, increasing input voltage ramp. A stepped input to the current source IC12A is processed through an R.C. network causing a time charge situation at the output of IC12B. Ramp time is set by the front panel ramp control.

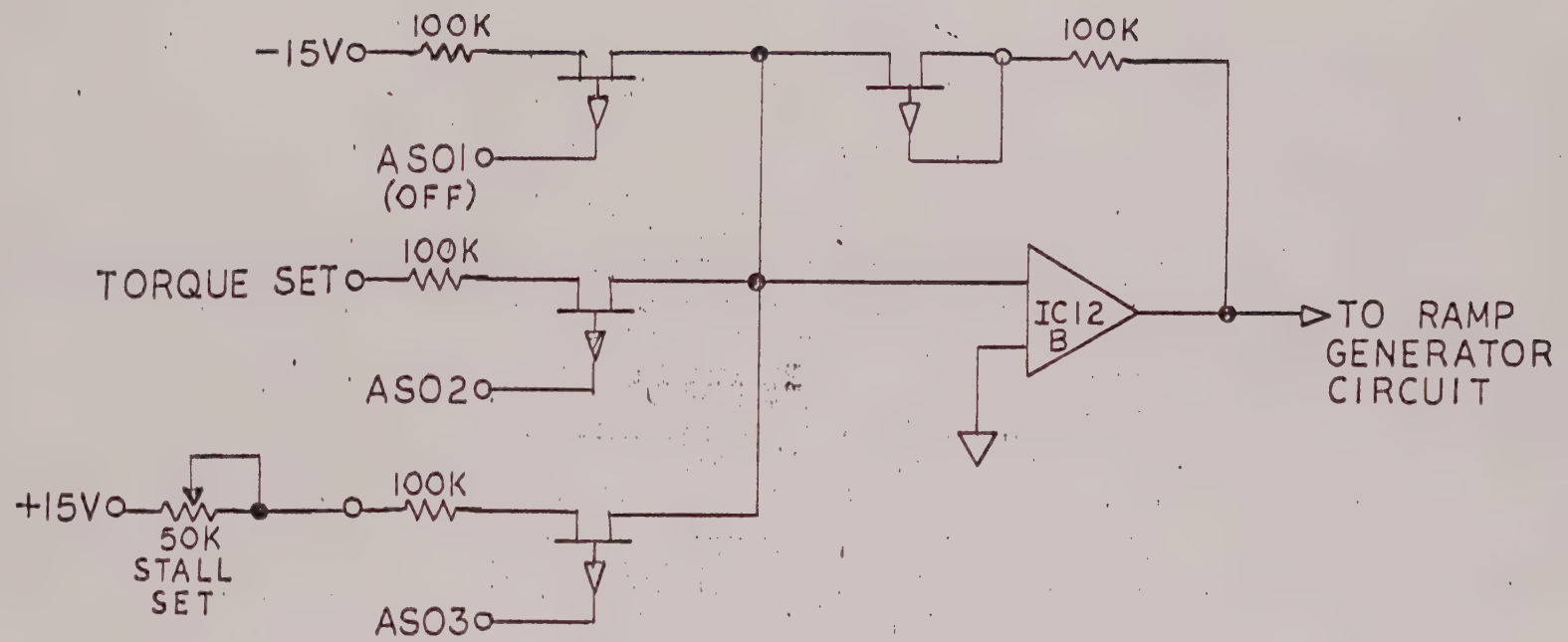


FIGURE 4-14

LOAD CONTROL (MODE SELECT) CIRCUIT

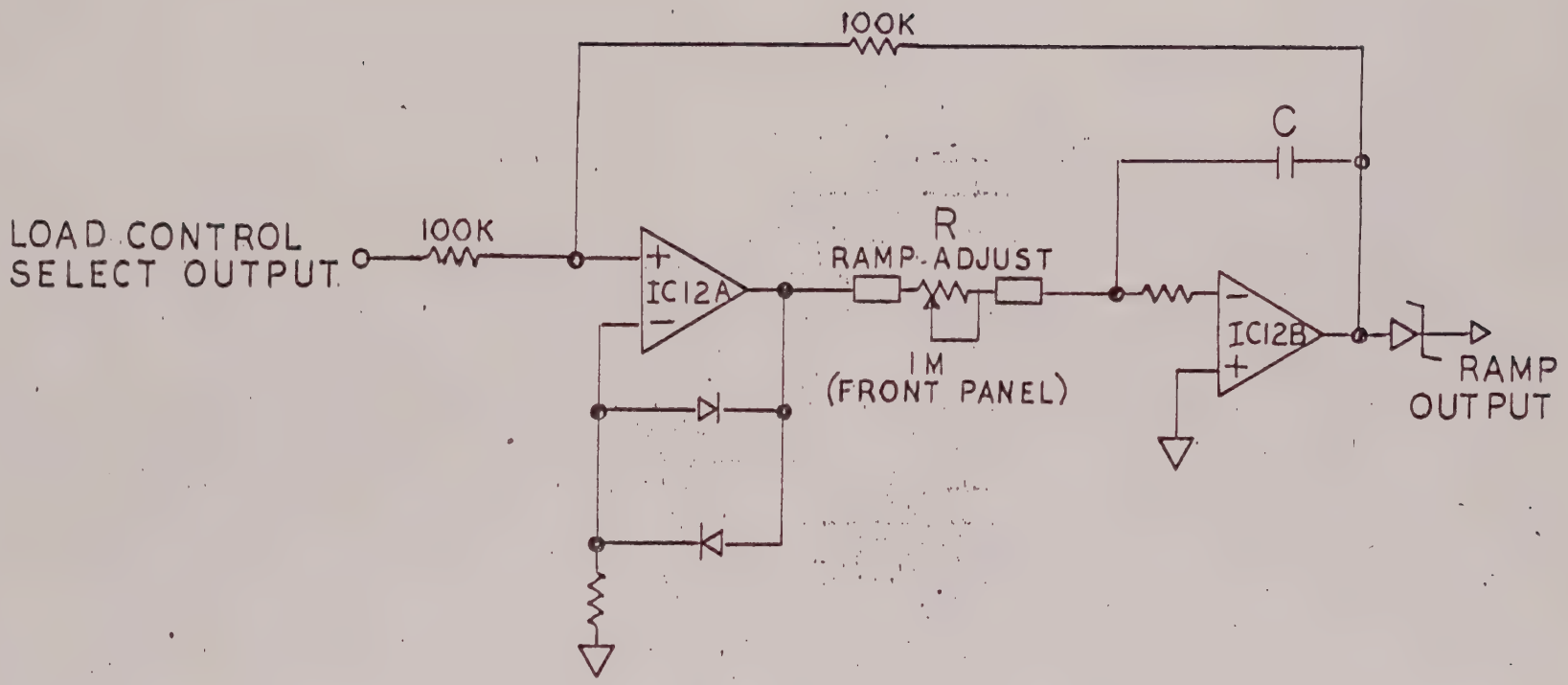


FIGURE 4-15

RAMP GENERATOR

SECTION V MAINTENANCE

5-1 INTRODUCTION

The instructions outlined in this section are the basic techniques that are recommended to maintain system accuracies. Only those circuits or instruments which require calibration procedures will be covered. Required test equipment will be covered per assembly. As with all instruments of this type, maintenance of this equipment require a skilled technician with a basic understanding of system design.

5-2 TRANSDUCERS

No maintenance on the transducers are recommended beyond recalibration

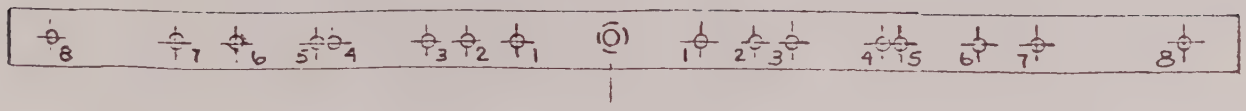
5-2-1 Static Calibration, Instroduction (Torque Transducer)

The torque transducer should not require frequent recalibration However, it may be necessary if it is suspected that the shaft has been overstressed or unless routine calibration checks are required. Calibration adjustments should only be attempted when it becomes necessary and only when the proper required equipment is available. Calibration of the torque transducer is accomplished by attaching a calibration beam to the torque transducer input shaft and locking to output end of the transducer shaft. By placing a known weight to the right side of the calibration beam at a prescribed distance from the shaft axis, a CW torque will result. This torque is the product of the distance of the weight from the shaft axis and the weight. By placing the weight to the left side of the calibration beam, a CCW torque will result. Adjustments are made with a trimmer type resistor located in the torque transducer and the "Zero" Adjust potentiomenter located on the instrument package.

5-2-2 Required Equipment (see Figure 5-1)

5-2-3 Initial Calibration Check

Attach the calibration beam to the input shaft of the torque transducer. Lock the output end of the shaft and level the calibration beam. Hang the 100% weight (from figure 6-1 on the right hand side of the beam and record the torque readout. Repeat this process for the 75%, 50% and 25% weights. Repeat the entire process with the weights on the left side of the beam. The results should be linear within $\pm$ 0.5% of fullscale torque.



TORQUE TRANSDUCER	WEIGHT	CALIBRATION POINT			
		100%	75%	50%	25%
TQ 10	1.25 oz.	6	4	3	1
TQ 32	4 oz.	6	4	3	1
TQ 50	4 oz.	8	7	5	2
TQ 100	8 oz..	8	7	5	2

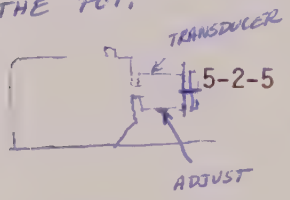
TORQUE TRANSDUCER	WEIGHT	CALIBRATION POINT			
		100%	75%	50%	25%
TQ-160	16 oz.	9	6	4	1
TQ-200	20 oz.	9.	6	4	1
TQ-320	32 oz.	9	6	4	1
TQ-400	32 oz.	10	8	5	2
TQ-512	32 oz.	12	11	7	3

FIGURE 5-1
CALIBRATION BEAM.

5-2-4 Calibration Procedure

Attach the calibration beam to the input shaft of the torque transducer. Lock the output end of the shaft and level the calibration beam. Hang the 100% weight on the right side of the beam and adjust the "Zero Adjust" potentiometer for a 100% torque reading and remove the weight. Hang the 100% weight on the left side of the beam, and remove the hold plug on the torque transducer which conceals the trim adjust potentiometer. record the torque reading. If the reading is lower than -100%, adjust the trimpot inside the transducer to obtain a reading above the -100% level by the same percentage of error that was recorded. Remove the weight and repeat the process until the transducer is within the ±0.5% tolerance. Repeat the calibration check described in 5-2-3 and check for hysteresis.

* TRIM POT IS ON BOTTOM OF TRANSDUCER. TO TAKE THE ALLEN SCREW OUT OF THE BOTTOM TO GET TO THE POT.



MJW
3/18/81

5-2-5 Speed Transducers

Calibration of the speed transducer requires a velocity standard such as a synchronous motor or a velocity comparison device such as a strobe light etc. Then calibrate the DC tachometer and remove the test head cover. Couple the prime mover to the test head. Allow the spindle to be driven at 1000 RPM and adjust the calibration trimmer located under the test head cover for a reading of 1000 RPM on the speed readout. Check linearity at several other speeds and correct if necessary. The results should be with .5% of span.

5-3 DTR 2600 and MODEL 2600 READOUT/CONTROL INSTRUMENT

Maintenance and calibrating procedures will require the following test equipment. A precision DC current and voltage source, DC voltmeter and an oscilloscope.

If frequent maintenance and claibration checks are to be performed, it is recommended that a transducer mock-up cable be fabricated. This cable could be utilized to the transducer substitution signals. The cable would require a lenght of coaxial cable and an Amphenol part number 17-20090 connector and 17/301/1 cable housing, or the cable could be purchased from Vibrac.

For the torque transducer simulation signal, connect a lenght of coaxial cable from the precision current source to pins 7 and 1 of the connector. (The return connection is made through pin 1). The calibration and accuracy checks that are to follow may be completed by

removing the instrument chassis and reconnecting the chassis to power on a suitable work bench.

5-3-1 Torque Signal Conditioner

To check the accuracy of the torque signal conditioner, insert the dummy torque transducer simulation signal into the transducer input connector. Connect the test DC voltmeter to the torque analog output connector, or connect the test DC meter to TP4 and the torque signal return ground (most convenient location is the shield of torque analog output connector). With a zero dummy torque input signal, check for any offset voltage on the DC voltmeter. The offset should be within $\pm$2 MV. If the offset is out of the acceptable limits, adjust the trimmer R34 (torque offset adjust) to read zero volts on the test DC voltmeter. Adjust the dummy torque input to -100 microamperes, and the DC voltmeter should read +10.00 volts. Adjust the dummy torque input for +100 microamperes, the DC voltmeter should read -10.00 volts. Adjust the dummy torque signal to check various points between the $\pm$ 100% points. The acceptable limits are to be within $\pm$ 0.1% of fullscale (see figure 1-3 for trimmer location). Connect the DC voltmeter to TP5 and adjust the dummy torque input to -100 microamperes, the DC voltmeter should read +10.00 volts. Adjust the dummy torque input to +100 microamperes, the DC voltmeter should read +10.00 volts. The acceptable limits are to be within $\pm$ .25% of full-scale. If the output is out of the acceptable limits, adjust the trimmer R45 (rectifier adjust) to correct the output within acceptable limits (see figure 1-3 for trimmer location). This adjustment may require several trials.

5-3-2 Lamp Driver Circuit

No maintenance is required for this circuit, However, we will note that the torque transducer lamp voltage may be monitored at TP1 and chassis ground.

5-3-3 Peak Torque Detector and Hold Circuit

To check the calibration of the peak torque circuit, insert the dummy torque input signal as described in 5-3-1. Connect the DC voltmeter to TP8 and the torque signal return ground. Press the "Reset" push-button switch and press the "Peak" push-button switch, adjust the dummy torque input signal to -100 microamperes

the DC voltmeter should read +10.00 volts. Adjust the dummy torque input to zero, the DC voltmeter should read +10.00 ±0.25% with a maximum allowable decay rate of 0.120% of full-scale per second. Press the "Reset" push-button switch and adjust the dummy torque input signal to +100 microamperes, press the "Peak" push-button switch, and the DC voltmeter should read +10.00 volts ± 0.25% with a maximum decay rate of 0.1% of full-scale per second. Press the "Reset" push-button switch and adjust the dummy torque input signal to check various points between ± 100% points. The acceptable linearity limits are to be within ± 1% of full-scale.

5-3-3 Digital Displays

See manufactures manual.

5-3-4 Stall Torque

To set the maximum stall torque level adjust the stall torque set trimmer on the digital board to the desired level (see figure 1-3 for trimmer location).

Note: This torque setting must be accomplished dynamically.

5-4 SYSTEM CALIBRATION

5-4-1 Required Test Standards

Accuracy checkouts and calibration require the use of precision test standards. The customer should carefully understand the component accuracies and provide for the appropriate test equipment for calibrating purposes. It is recommended that routine calibration checkouts be performed on the instrument to certify that the MUT test data accumulated is accurate and repeatable. It will be noted that the listing of the calibration standards to be described are recommended examples of suitable testing standards for Dynomometer instruments, however, customer requirements govern the actual needs for such equipment.

The following equipment is recommended:

5-4-2 Torque Transducer Certification

A calibration kit for each transducer which includes a set of NBS class 5 weights and a calibration beam which mounts on the transducer shaft. Consult factory for availability of standard kits.

5-4-3 General Calibration Certification

Calibration certification may be easily accomplished on a routine basis by testing for readout accuracy with the appropriate testing standards. For example, if the instrument is used for incoming inspection, testing it may be desirable to certify the system on a weekly basis by completing the following calibration checks:

1. Torque transducer calibration checkout as described in 5-2.
2. Signal conditioner calibration checkout as described in 5-3. and 5-4.

5-4-4 System Calibration Procedures

To run a complete system calibration perform the following sequence of procedures.

5-5-4-1 Turn power on and allow for a one hour warm up period.

5-5-4-2 Perform maintenance and claibration procedures for the display instrument as described in Section 5-3.

5-5-4-3 Perform maintenance and calibration instructions for the torque transducer as described in Section 5-2.

SECTION VI SCHEMATICS

6-1 SCHEMATICS

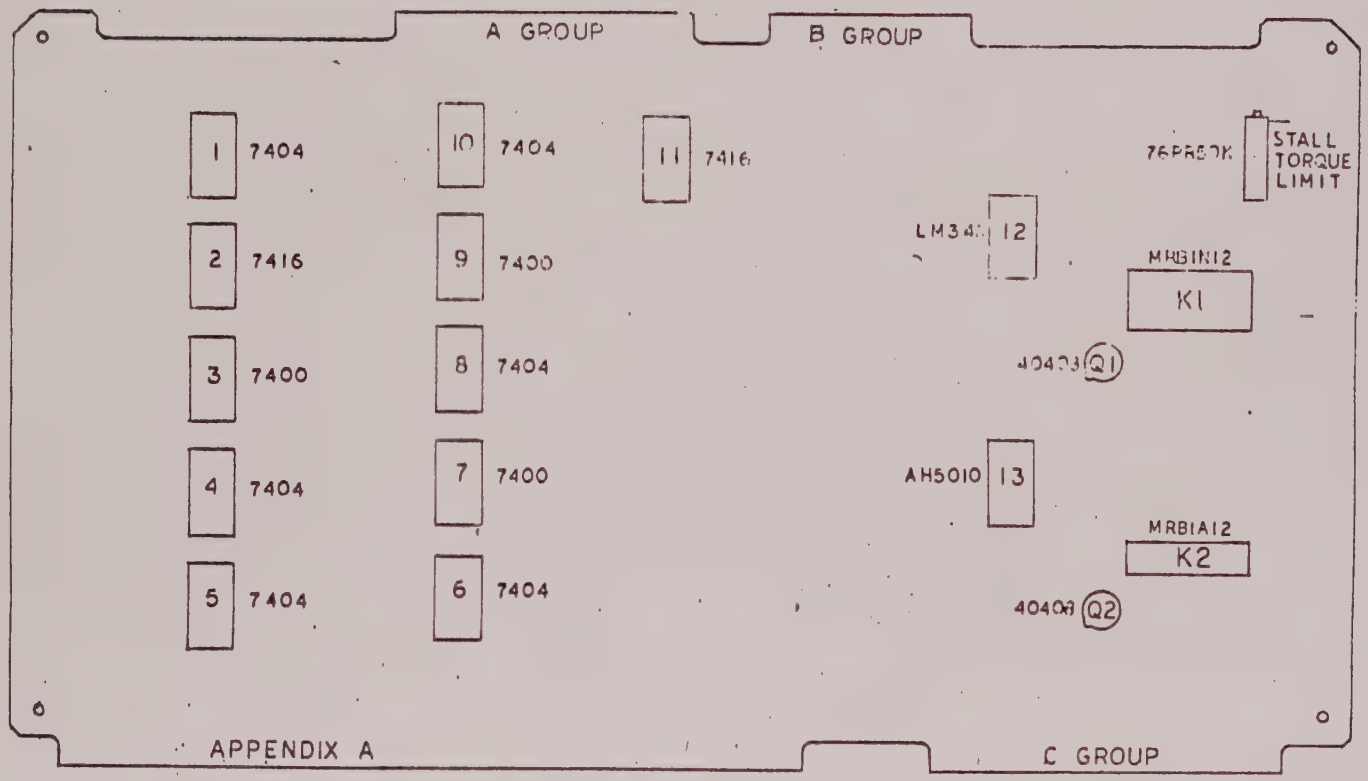
Drawing #	Description
B 8013	Torque Scaler Circuit
B 8019	Lamp Driver Circuit
B 8020	Torque Signal Conditioner
B 8021	Peak Torque Detector
B 8022	Peak Torque Comparator
B 8023	TQ Hold Circuit
B 8024	Speed Signal Conditioner (2600 only)
B 8027	Load Regulator
D 4706	Signal Conditioner Board
D 8011	Logic Board Schematic
B 8010	Logic Board Layout

SECTION VII MANUFACTURES MANUALS

7-1 POWER SUPPLIES

7-2 DIGITAL READOUTS

NUMBER B-



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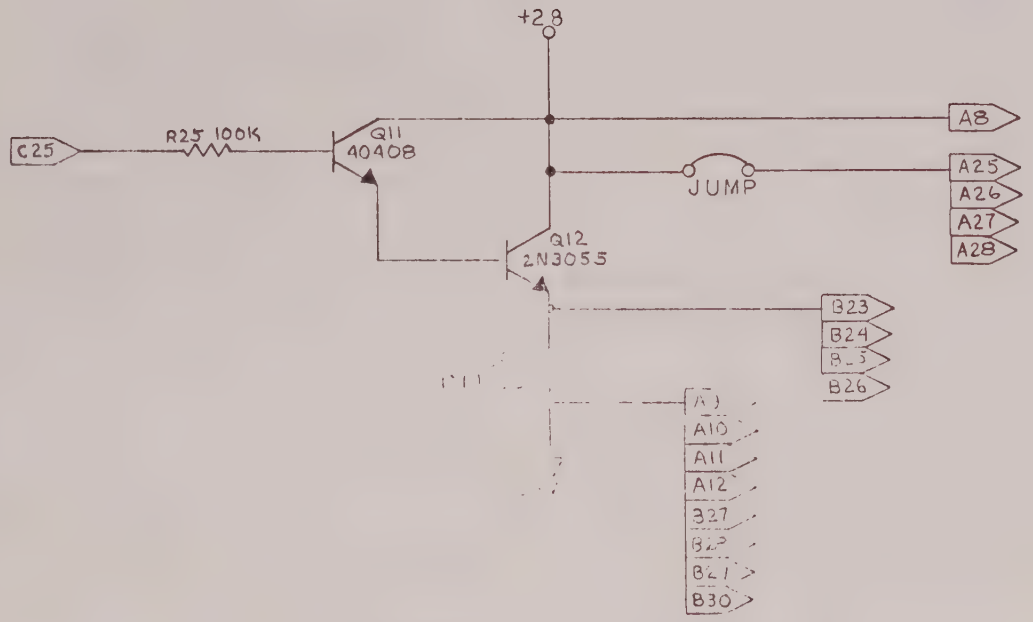
MATERIAL	
FINISH	
DO NOT SCALE DRAWING REMOVE BURRS - BREAK SHARP EDGES	TOLERANCES DEC .XX=±.010 FRACT =±1/64 XXX=±.005 ANGLES =±1°

REVISIONS

Vibrac CORPORATION

TITLE	LAYOUT-LOGIC SCHEM.
DRAWN VTR DATE 8-13-79	USED ON DTR SERIES
CHECKED	REF. DWG
APPROVED	CUSTOMER
NUMBER B- 8010	

NUMBER B- 8027 REV



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MATERIAL

FINISH

DO NOT SCALE DRAWING
REMOVE BURRS - BREAK SHARP EDGES

TOLERANCES
DEC XX = ± .010 FRACT = ± 1/64
XXX = ± .005 ANGLES = ±1°

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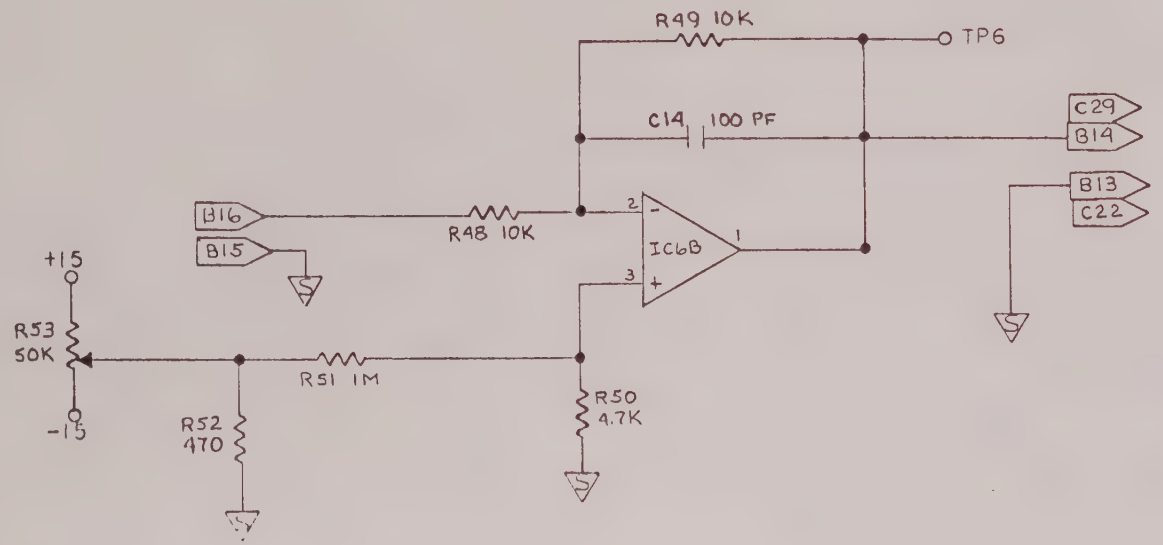
Vibrac® CORPORATION

TITLE LOAD REGULATOR

DRAWN V.J.R DATE 8/31/79	USED ON
CHECKED	REF DWG. D2706
APPROVED	CUSTOMER

NUMBER B- 8027 REV



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MATERIAL	
FINISH	
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Vibrac® CORPORATION

TITLE SPEED SIGNAL CONDITIONER	
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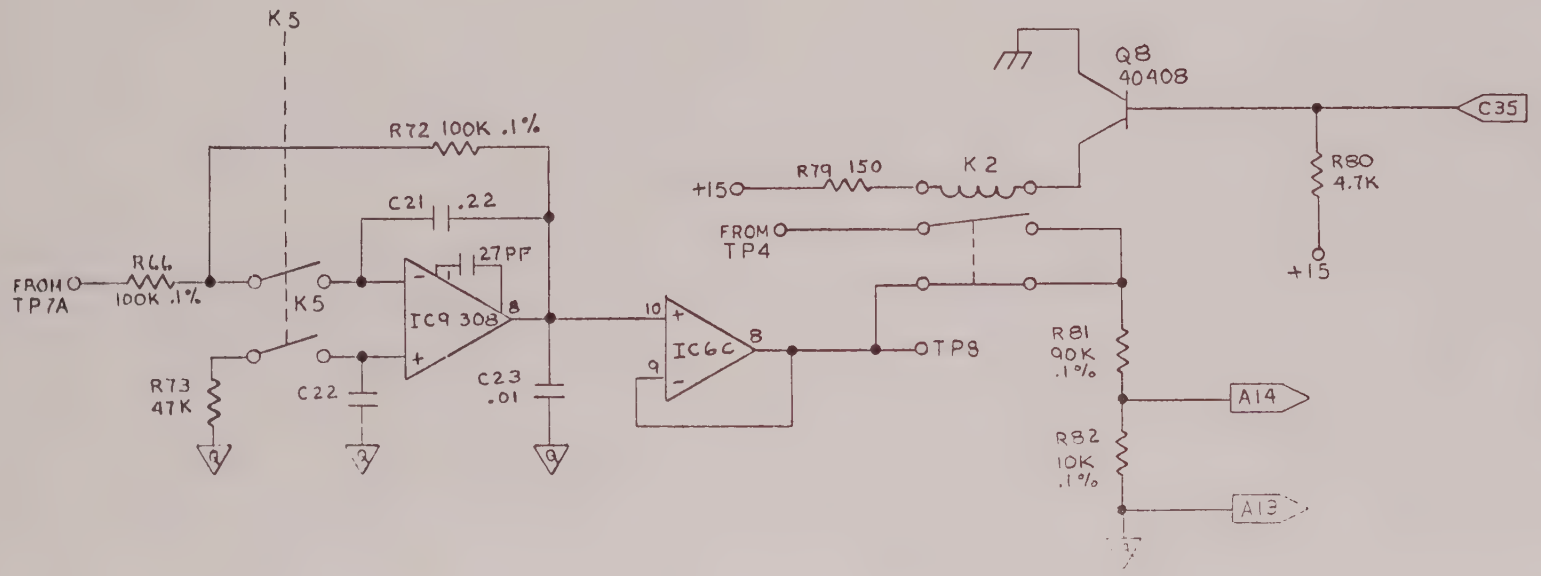
CHECKED	REF DWG D4706
APPROVED	CUSTOMER
NUMBER B- 8024	REV

NUMBER B- 5023 REV



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MATERIAL

FINISH

DO NOT SCALE DRAWING
REMOVE BURRS - BREAK SHARP EDGES

TOLERANCES
DEC XX = ± 010 FRACT
XXX = ± 005 ANGLES

REVISIONS

Vibrac CORPORATION

TITLE TQ HOLD CIRCUIT

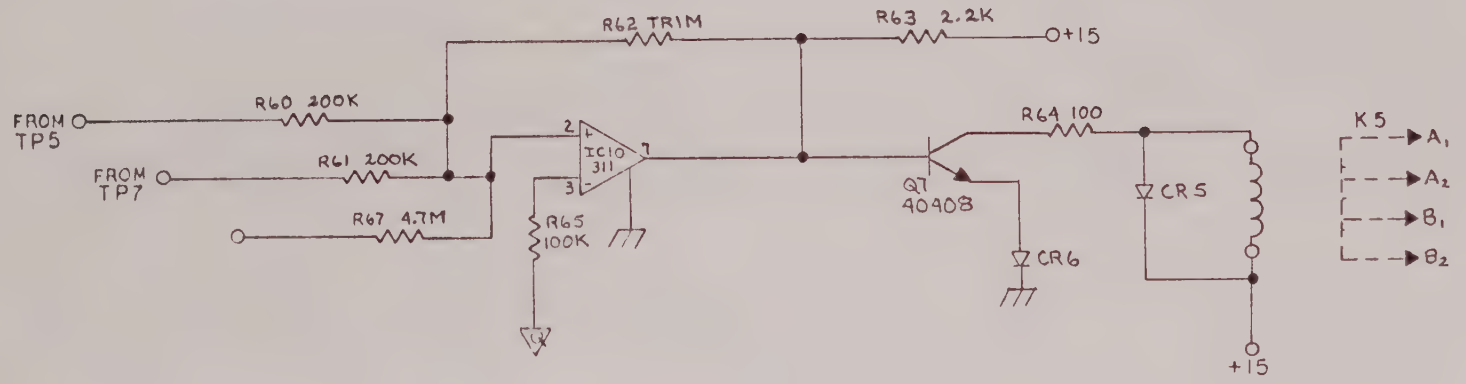
DRAWN VJR DATE 8/10/79
USED ON

CHECKED
REF DWG. D4701

APPROVED
CUSTOMER

NUMBER B- 5023 REV

NUMBER B- 3022 REV



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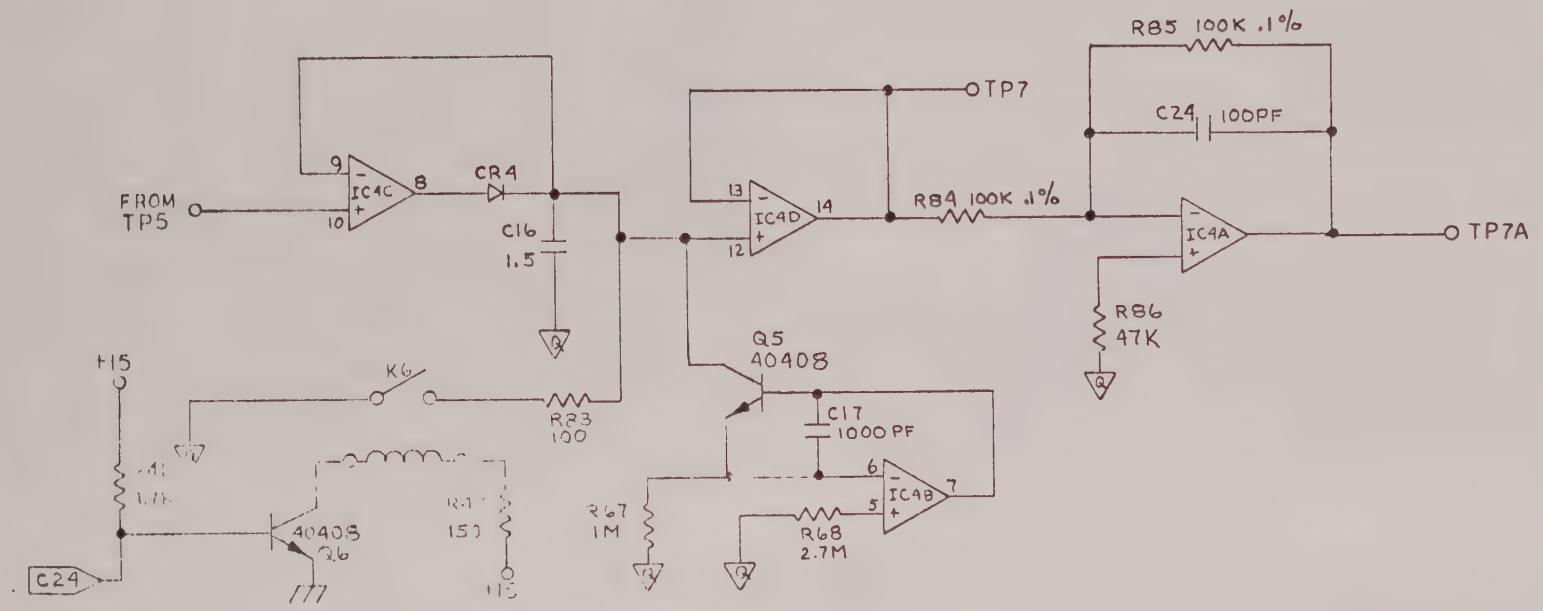
MATERIAL	
FINISH	
DO NOT SCALE DRAWING REMOVE BURRS, BREAK SHARP EDGES	TOL. UNLESS OTHERWISE SPECIFIED DEC. XX ±.010 FRACT. ±1/64 ANGLES ±1°

REVISIONS

Vibrac CORPORATION

TITLE: PEAK TQ/TQ COMPARATOR	
DRAWN VJR DATE 8-30-7	USED ON
CHECKED	REF DWG D4706
APPROVED	CUSTOMER
NUMBER B- 3022	REV

NUMBER B- 8021 | REV



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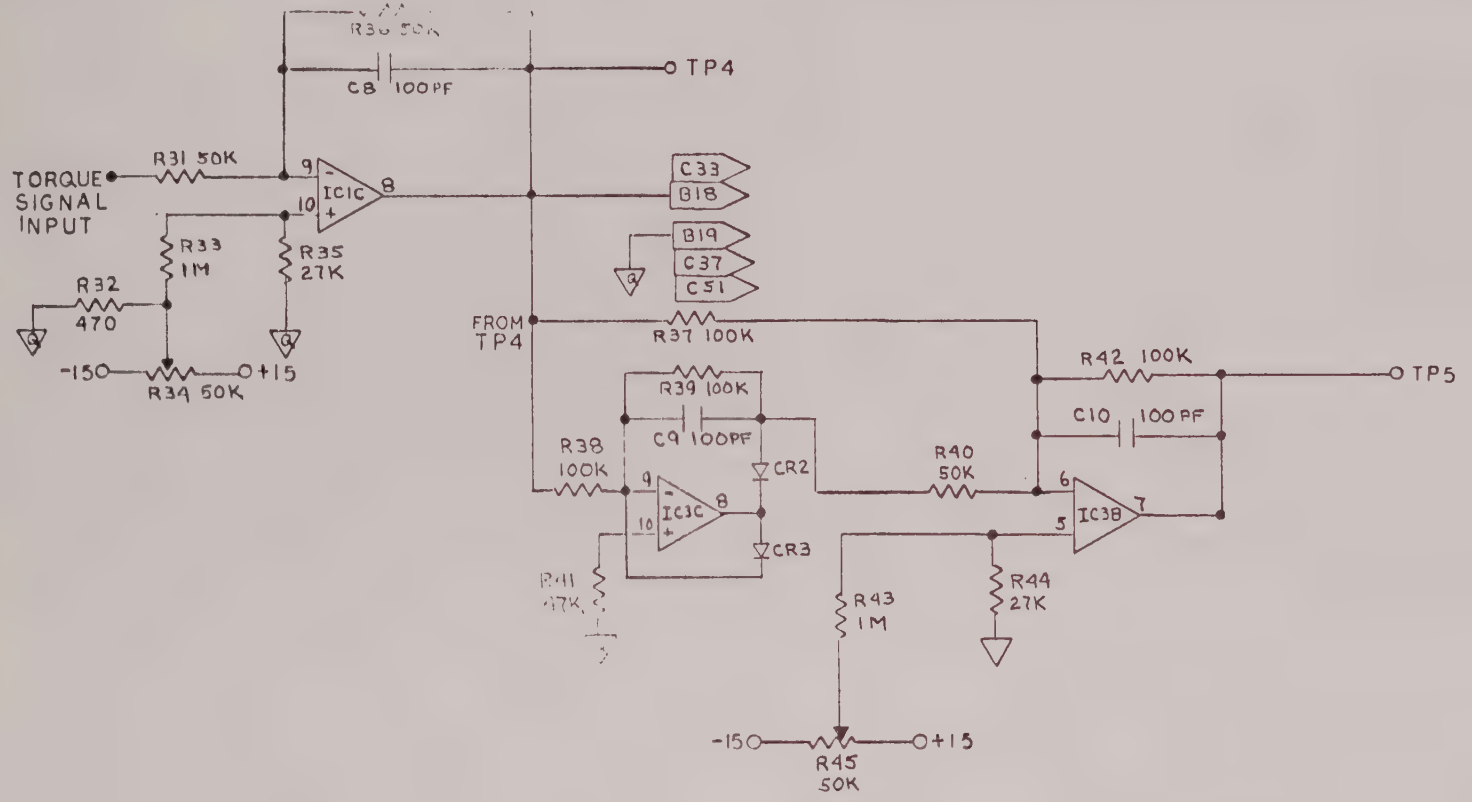
MATERIAL	
FINISH	
DO NOT SCALE DRAWING REMOVE BURRS BREAK SHARP EDGES	TOLERANCES DEC XX= ± .010 FRACT = ±1/64 XXX= ± .005 ANGLES = ±1°

REVISIONS

Vibrac® CORPORATION

TITLE: PEAK TORQUE DETECTOR	
DRAWN: VJR DATE: 8-30-79	USED ON
CHECKED	REF DWG. D4706
APPROVED	CUSTOMER
NUMBER: B- 8021	REV

NUMBER B- 8020 REV



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MATERIAL	
FINISH	
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REVISIONS

Vibrac CORPORATION

TITLE: TORQUE SIGNAL CONDITIONER	
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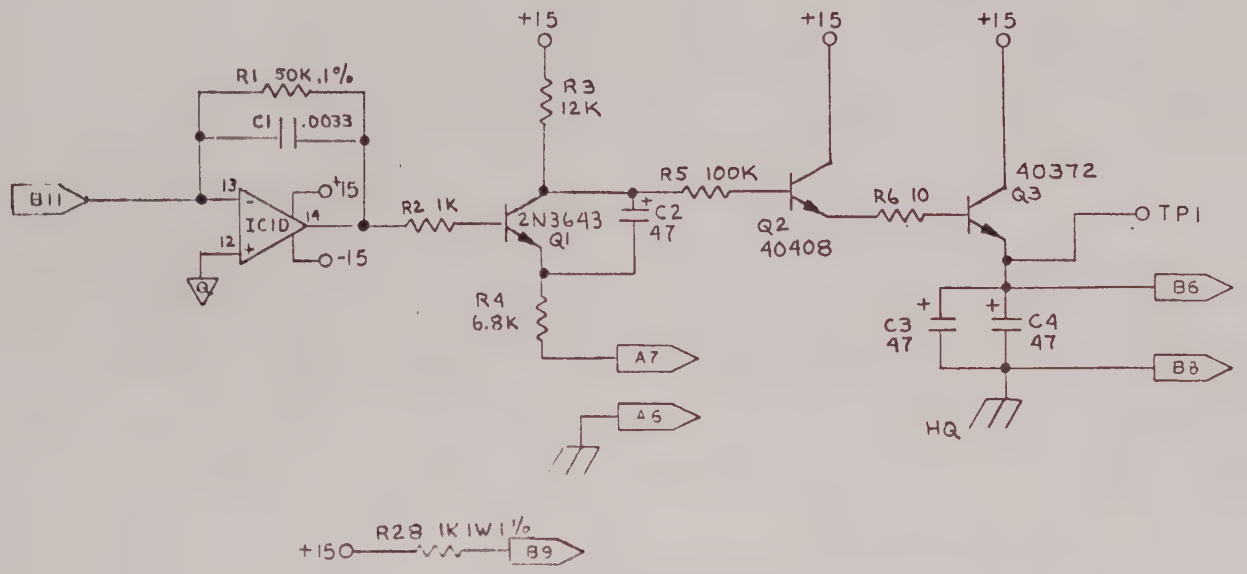
CHECKED	REF. DWG. D 4706
APPROVED	CUSTOMER
NUMBER B- 8020	REV

NUMBER B- 8019 | REV



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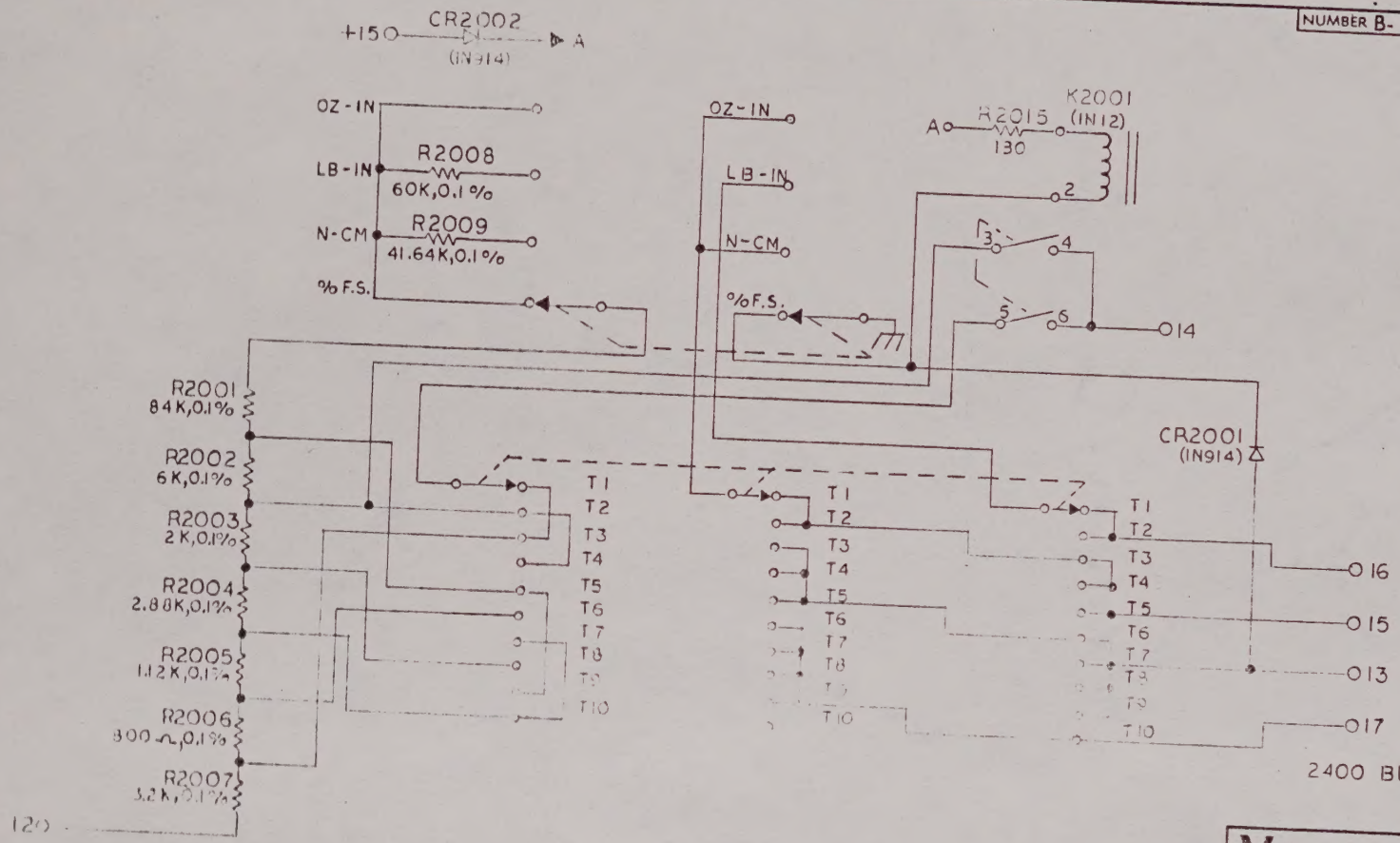
MATERIAL	
FINISH	
DO NOT SCALE DRAWING REMOVE BURRS - BREAK SHARP EDGES	TOLERANCES DEC .XX=±.010 FRACT =±1/64 XXX=±.005 ANGLES =±1°

REVISIONS

Vibrac CORPORATION

TITLE	LAMP DRIVER CIRCUIT
DRAWN VJR DATE 8-29-74	USED ON
CHECKED	REF. DWG. D 4706
APPROVED	CUSTOMER
NUMBER B- 8019	REV

NUMBER B- 8013 REV



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MATERIAL	
FINISH	
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REVISIONS

Vibrac® CORPORATION

TITLE SCALER (TORQUE)	
DRAWN VJR DATE 8-16-79	USED ON
CHECKED PAS 8-16-79	REF. DWG.
APPROVED	CUSTOMER
NUMBER B- 8013	REV

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